# The Welding Engineer

Reg. U. S. Pat. Office

Founded by L. B. Mackenzie, 1916

OCTOBER, 1929 VOL. 14, NO. 10

$3.00 per year in U. S. 608 S. Dearborn St., Chicago, Ill. $4.00 per year abroad



# TOBIN BRONZE

**—the most satisfactory material for general oxy-acetylene welding**

**High Tensile Strength**
**Ductility, Uniform Composition, Little Or No Pre-heating**
**Low Melting Point**

ANACONDA
from mine to consumer

**ANACONDA WELDING RODS**

**THE AMERICAN BRASS COMPANY**
General Offices: Waterbury, Connecticut
The name "TOBIN BRONZE" is registered in the U. S. Patent Office



*Published monthly by the Welding Engineer Publishing Co. Entered as second class matter Jan. 30, 1916, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.*

# 5 REASONS WHY

## Practically every car and body manufacturer and many parts and accessory manufacturers are using Elkonite Resistance Welding Dies and Electrodes:

1. The cost of forgings is greatly reduced, the parts being made in two or more pieces and welded together with Elkonite.
2. Elkonite welds parts together with a fine degree of accuracy, enabling the smaller parts to be machine-finished before welding.
3. Due to the long life of Elkonite, high speed production is maintained.
4. The factor of safety in fabrication is increased by the accuracy and strength of Elkonite welds.
5. Manual labor is reduced by less redressing and high speed automatic operation.

The value of these five factors cannot be rated too highly. They are of vital importance not only to manufacturers in the Automotive Industries but to every manufacturer engaged in the fabrication of metals.

Projection welding, in particular, represents a typical example of the economy effected by Elkonite. This method is rapidly replacing spot welding in all instances where one or more welds are necessary to fabricate a complete part. Any number of welds, within the capacity of the machine used, can be made simultaneously by the projection method. The saving in time and cost is obvious.

Elkonite is being used successfully not only in the welding field but wherever a hard, wear-resistant material is required. The most outstanding of these uses is found at present in its application as the bushing material in seam welding machines.

Our latest booklet, "Elkonite Die and Electrode Applications in Resistance Welding" describes in detail many varied applications of Elkonite, some of which no doubt parallel your own resistence welding problems. Sent upon request, without obligation, of course.

### Compare

**these *ELKONITE* records with your own jobs:**

***Projection Welding****

**Job: Steel reinforcement to chassis frame**
**Life of Copper Dies: Impractical with copper**
***ELKONITE* Dies: 50,000 welds**

***Flash Welding****

**Job: Flywheel ring gear**
**Life of Copper Dies: 3,000 welds**
***ELKONITE* Dies: 59,000 welds**

***Seam Welding****

**Job: Steel horn**
**Life of Copper Dies: 200 pieces****
***ELKONITE* Dies: 10,300 pieces****

***Spot Welding****

**Job: Automobile Body Parts**
**Life of Copper Dies: 10 minutes****
***ELKONITE* Dies: 8 hours****
(Machine runs at 250 welds per min.)

***Electrical Upsetting***

**Job: Roller bearing assembly**
**Life of Copper Dies: 24,000 welds**
***ELKONITE* Dies: 399,000 welds**

*Name of manufacturers using this application, upon request
**Per each redressing

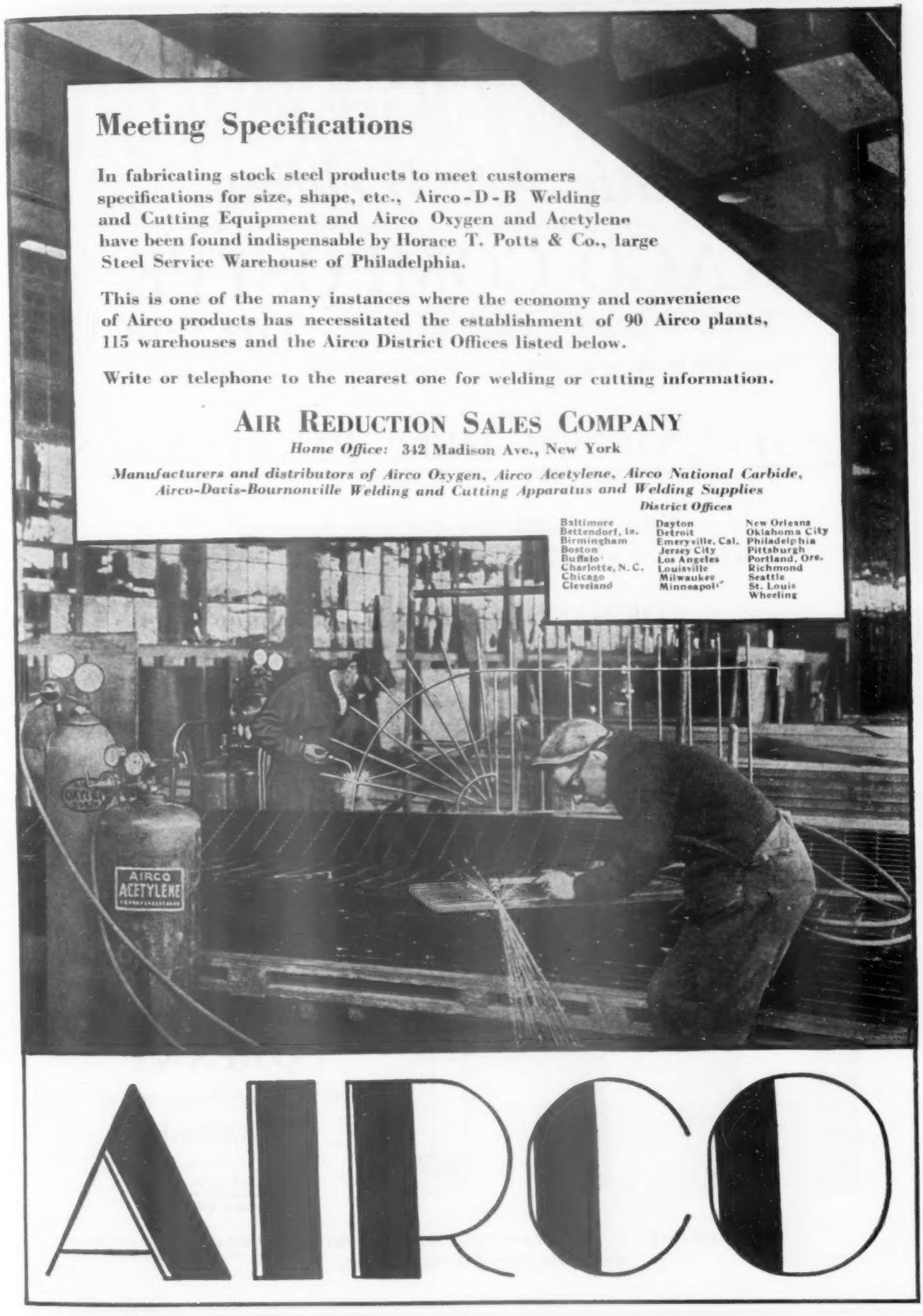
***ELKON*, Inc.**
**Division of P. R. Mallory & Company, Inc.**
**Indianapolis, Ind.**

*Exclusive licensees under General Electric Company patents dated May 28, 1925 and Sept. 1, 1925. Other patents pending.*

# ELKONITE

REG. U.S. PAT. OFF.

**Dies and Electrodes for Resistance Welding**




## Meeting Specifications

**In fabricating stock steel products to meet customers specifications for size, shape, etc., Airco-D-B Welding and Cutting Equipment and Airco Oxygen and Acetylene have been found indispensable by Horace T. Potts & Co., large Steel Service Warehouse of Philadelphia.**

**This is one of the many instances where the economy and convenience of Airco products has necessitated the establishment of 90 Airco plants, 115 warehouses and the Airco District Offices listed below.**

**Write or telephone to the nearest one for welding or cutting information.**

### AIR REDUCTION SALES COMPANY

*Home Office:* 342 Madison Ave., New York

***Manufacturers and distributors of Airco Oxygen, Airco Acetylene, Airco National Carbide, Airco-Davis-Bournonville Welding and Cutting Apparatus and Welding Supplies***

*District Offices*

| | | |
|---|---|---|
| Baltimore | Dayton | New Orleans |
| Bettendorf, Ia. | Detroit | Oklahoma City |
| Birmingham | Emeryville, Cal. | Philadelphia |
| Boston | Jersey City | Pittsburgh |
| Buffalo | Los Angeles | Portland, Ore. |
| Charlotte, N. C. | Louisville | Richmond |
| Chicago | Milwaukee | Seattle |
| Cleveland | Minneapolis | St. Louis |
| | | Wheeling |

AIRCO

# *An Improved Wire for Automatic Arc Welding*

# RACO COMPOSITE

TYPE C-6 TYPE C-8 TYPE C-18

**Furnished in three grades. The numerals denote carbon content.**

## FAST - UNIFORM - DEEP PENETRATION

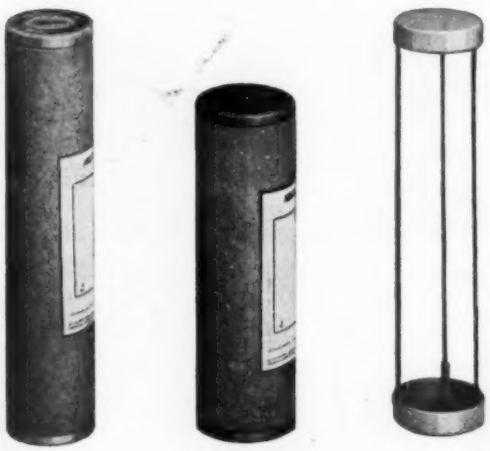
**May we send you samples prepaid?**
**Sizes in stock -3/32″-1/8″-5/32″-3/16″-7/32″-1/4″**

FOR HAND WELDING

Bare electrodes
Bare annealed electrodes
Dusted electrodes
Composite Type "A" & "B" high speed electrodes
Flux coated electrodes
Copper coated and plain finish gas welding wires
Nickel Steel Rods
Semi-High Carbon Rods
High Carbon Rods

*The New "Raco" Package*

**Patent applied for**



**A new catalog in color is now ready. Please ask for your copy.**

**REID-AVERY COMPANY**

**21st and Washington Ave.**
**Philadelphia**

**Pacific Coast Distributors:**
**M. E. Canfield Company, 316 Commercial Street, Los Angeles, California**

***Some exclusive territories are open for distributors of this very desirable line of welding wires.***

# The Welding Engineer

Founded by L. B. Mackenzie, 1916

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## Pride in Their Product

THERE recently appeared in *Revue de la Soudure Autogene* a page of very interesting comment on the advertising of technical products by American manufacturers. The article uses one American advertisement of a gas pressure regulator and comments on the exacting care with which the virtues of this regulator are explained in the advertising. It speaks of the art of advertising as developed by American manufacturers who offer their merchandise to possible users without limiting themselves to a simple statement of superiority, but rather going into great detail to attract the greatest possible amount of attention to the point of superiority. "It is true," states the author, "that Americans often make use of publicity methods which we do not consider suitable but it must be recognized that they are past masters in the art of advertising of a purely technical character. One recognizes in it a love of the manufacturer for his work, which does not prevent him from making frequent changes in his models to please the public, and put him in a position to offer them constantly merchandise which is better and more attractive." This tribute to American advertising genius is well deserved and it is interesting to note that the buying public has the same warm feeling toward advertising that the seller has. The average buyer can read in an advertisement a genuine pride in the product and naturally selects the advertised product.

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Last Advertising forms close at 8:00 a. m. on the 12th. To show proof for correction copy must be received at an earlier date and allowances should be made for delay to mails. All copy should be in by the 12th of the month at the latest.

The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

Authorized Representatives

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AUSTRALIA AND NEW ZEALAND—R. Hill, Matlock House, Davenport, Auckland, New Zealand.
SOUTH AFRICA—J. W. Arnison, 35a Victoria Ave., Benoni, Transvaal, South Africa.

# Buyers' Index

*Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.*

**ACETYLENE (Compressed in Cylinders)**
Air Reduction Sales Co.
Commercial Acetylene Supply Co.
Kansas City Oxygen Gas Co.
Modern Engineering Co.
International Oxygen Co.
Prest-O-Lite Co.

**ACETYLENE CYLINDERS**
Pressed Steel Tank Co.

**ACETYLENE WELDING WIRE**
Air Reduction Sales Co.
American Brass Co.
American Steel Engineering Co.
American Steel & Wire Co.
Atlas Foundry Co.
Central Steel & Wire Co.
Craftsweld Equipment Co.
Edgcomb Steel Co.
Fusion Welding Corporation
Hollup Corp.
Igoe Brothers
Imperal Brass Mfg. Co.
Kansas City Oxygen Gas Co.
Koro Corporation
Mueller Brass Co.
Oxweld Acetylene Co.
Page Steel & Wire Co.
Reid-Avery Co.
Roebling, John A., Sons Co.
Seneca Wire Mfg. Co.
St. Paul Welding & Mfg. Co.
Steel Sales Corp.
Stoody Co.
Joseph T. Ryerson & Sons, Inc.
Taylor-Wharton Iron & Steel Co.
Torchweld Equipment Co.
Wickwire Spencer Steel Corp.
Weldit Acetylene Co.
Williams & Co.

**ALUMINO-THERMIC WELDING**
Metal & Thermit Corporation

**ALUMINUM SOLDER**
Crown Aluminum Solder Co.

**ANNEALING FURNACES**
General Electric Co.
Westinghouse Elec. & Mfg. Co.

**APRONS (Asbestos)**
Ideal Face Shield Co.
Olympic Glove Co.

**ASBESTOS INSULATED WIRE AND CABLE**
Central Steel & Wire Co.

**BENCHES, WELDING**
Standard Pressed Steel Co.

**BLOW PIPES**
See "Torches"

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The Welding Engineer Pub. Co.
General Electric Co.
Lincoln Electric Co.
Linde Air Products Co.
Electric Arc Cutting & Welding Co.

**BRAZING OUTFITS**
Air Reduction Sales Co.
Bastian-Blessing Co.
Craftsweld Equipment Co.
General Welding and Equipment Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Kansas City Oxygen Gas Co.
K-G Welding & Cutting Co.
Alexander Milburn Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Sight Feed Generator Co.
Torchweld Equipment Co.
Victor Welding Equipment Co.
Williams & Co.

**BRONZE FILLER RODS**
American Brass Co.
Bridgeport Brass Co.
Central Steel & Wire Co.
Chase Brass and Copper Co., Inc.
Mueller Brass Co.
Oxweld Acetylene Co.
Steel Sales Corp.

**BUFFERS**
R. G. Haskins Co.
N. A. Strand & Co.

**BUTT WELDERS**
See "Electric Resistance Welders"

**CABLE (Arc Welding)**
Allan Mfg. & Welding Co.
Central Steel & Wire Co.
Fusion Welding Corp.
Electric Arc Cutting & Welding Co.
General Electric Co.
Gibb Welding Machines Co.
Hollup Corp.
Lincoln Electric Co.
Quasi-Arc, Inc.
John A. Roebling Sons Co.
Joseph T. Ryerson & Sons, Inc.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

**CARBIDE**
Air Reduction Sales Co.
National Carbide Co.
Shawinigan Products Corp.
Union Carbide Sales Co.

**CARBON (Blocks, Paste, Electrodes, etc.)**
Air Reduction Sales Co.
Central Steel & Wire Co.
Electric Arc Cutting & Welding Co.
National Carbon Co.
Oxweld Acetylene Co.

**CARBON BURNING EQUIPMENT**
Air Reduction Sales Co.
Bastian-Blessing Co.
Craftsweld Equipment Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Kansas City Oxygen Gas Co.
K-G Welding & Cutting Co.
Milburn, Alexander Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
Victor Welding Equipment Co.

**CAST IRON SOLDER**
Crown Aluminum Solder Co.

**CAUSTIC POTASH**
Innis, Speiden & Company

**CUTTING ELECTRODES (Electric Arc)**
Allan Mfg. & Welding Co.
Arcos, Inc.
Electric Arc Cutting & Welding Co.
Fusion Welding Corp.
General Electric Co.
Lincoln Electric Co.
National Carbon Co.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

**CYLINDERS (Acetylene)**
Pressed Steel Tank Co.

**CYLINDERS (Oxygen, Hydrogen)**
Chas. L. Gulick
Harrisburg Pipe & Pipe Bending Co.
Wm. Wharton, Jr., Co.

**DRILLS, PORTABLE ELECTRIC**
R. G. Haskins Co.
Stoody Company
N. A. Strand & Co.

**ELECTRIC ARC WELDING OUTFITS**
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American Steel Engineering Co.
Burke Electric Co.
Electric Arc Cutting & Welding Co.
Electric Welding Machine Co.
Fusion Welding Corporation
General Electric Co.
Goodman Electric Machinery Co.
Gibb Welding Machines Co.
Hollup Corp.
Lincoln Electric Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Quasi-Arc Incorporated
Joseph T. Ryerson & Sons, Inc.
Shrader Electric Co.
Stoody Co.
Waters Welders, Inc.
Westinghouse Elec. & Mfg. Co.
Williams & Co.
Wilson Welder & Metals Co.

**ELECTRIC RESISTANCE WELDERS**
Federal Machine & Welder Co.
General Electric Co.
Gibb Welding Machines Co.
Goodman Electric Machinery Co.
Joseph T. Ryerson & Son

**ELECTRODES (Carbon Arc Welding)**
See "Cutting Electrodes"

**ELECTRODES (Metallic Arc Welding)**
American Steel & Wire Co.
American Steel Engineering Co.
Arcos, Inc.
Atlas Foundry Co.
Central Steel & Wire Co.
Edgcomb Steel Co.
Electric Arc Cutting & Welding Co.
Fusion Welding Corporation
General Electric Co.
Gibb Welding Machines Co.
Hollup Corp.
Igoe Brothers
Koro Corporation
Lincoln Electric Co.
Maurath, Inc.
National Welding Products Corp.
Page Steel & Wire Co.
Quasi-Arc, Incorporated
Reid-Avery Co.
Roebling, John A., Sons Co.
Joseph T. Ryerson & Sons, Inc.
Seneca Wire & Mfg. Co.
Steel Sales Corp.
Stoody Company
Taylor-Wharton Iron & Steel Co.
Wickwire Spencer Steel Corp.
Williams & Co.
Wilson Welder & Metals Co.

**ELECTRODE HOLDERS**
Allan Mfg. & Welding Co.
Burke Electric Co.
Electric Welding Machine Co.
Fibre-Metal Products Co.
Fusion Welding Corporation
General Electric Co.
Gibb Welding Machines Co.
Hollup Corp.
Koro Corporation
Lincoln Electric Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Stoody Co.
Waters Welders, Inc.
Westinghouse Elec. & Mfg. Co.
Williams & Co.
Wilson Welder & Metals Co.

**ELECTRODE TIPS (Resistance Welding)**
Elkon, Inc.

**ELECTROLYTIC OXYGEN AND HYDROGEN GENERATING EQUIPMENT**
International Oxygen Co.

**FACE SHIELDS (Arc Welding)**
Allan Mfg. & Welding Co.
Burke Electric Co.
Central Steel & Wire Co.
Chicago Eye Shield Co.
Electric Arc Cutting & Welding Co.
Fibre-Metal Products Co.
Fusion Welding Corporation
General Electric Co.
Gibb Welding Machines Co.
Hollup Corporation
Ideal Face Shield Co.
Lincoln Electric Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Quasi-Arc, Incorporated
Stoody Company
Joseph T. Ryerson & Sons, Inc.
Sellstrom Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Waters Welders, Inc.
Williams & Co.
Wilson Welder & Metals Co.
Willson Products, Inc.

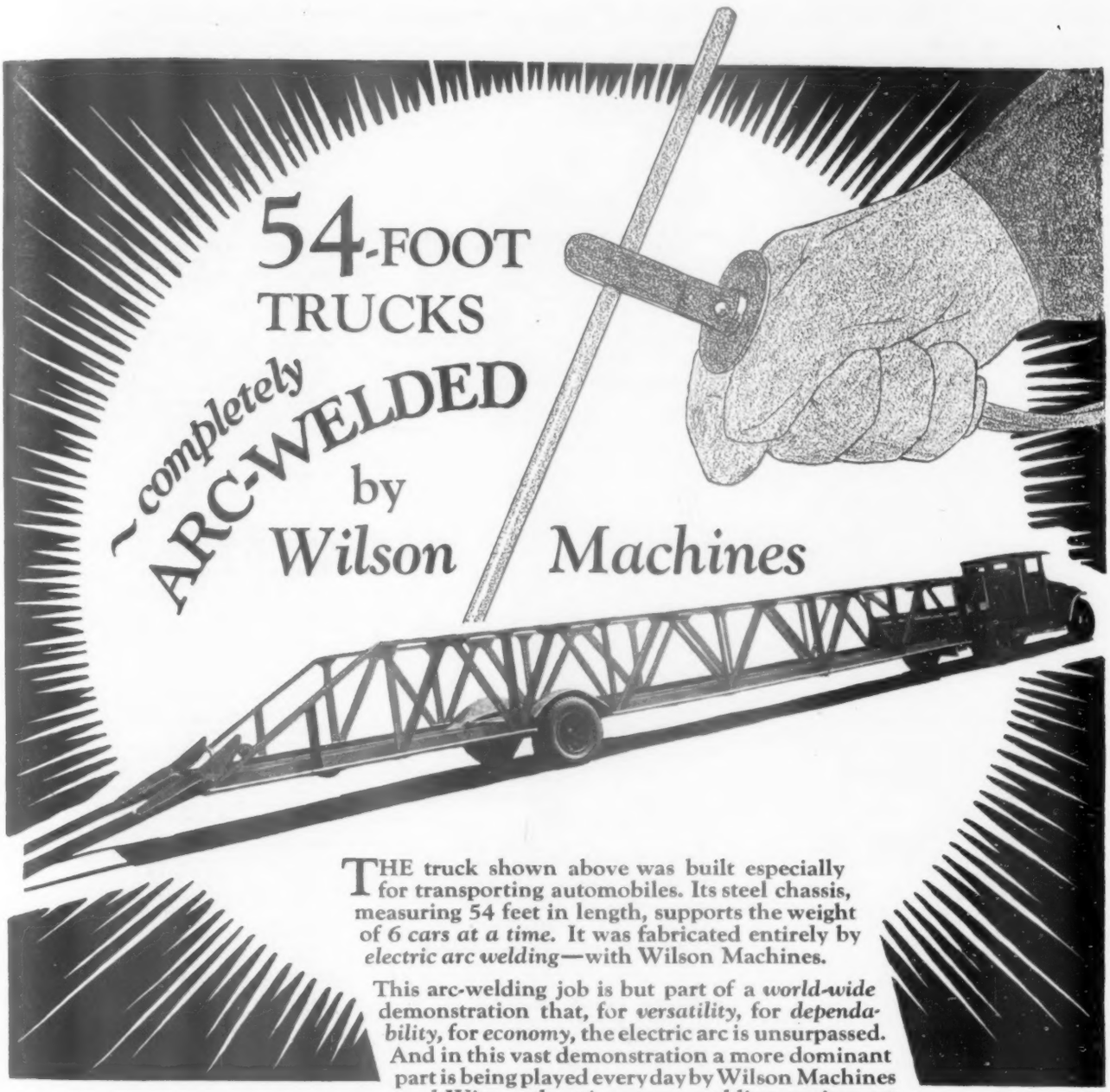
**FIREPROOF PLASTIC MATERIAL**
Air Reduction Sales Co.
National Carbon Co.

**FLANGES, WELDING**
Bonney Forge & Tool Works

**FLUE WELDERS (Electric)**
General Electric Co.
Joseph T. Ryerson & Sons, Inc.

**FLUXES**
Air Reduction Sales Co.
Anti-Borax Compound Co.
Kansas City Oxygen Gas Co.
Metal & Thermit Corp.
Central Steel & Wire Co.
Modern Engineering Co.
Oxweld Acetylene Co.

# 54-FOOT TRUCKS completely ARC-WELDED by Wilson Machines

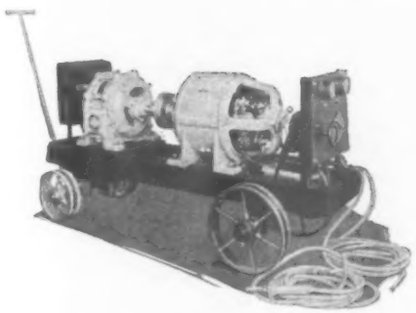


THE truck shown above was built especially for transporting automobiles. Its steel chassis, measuring 54 feet in length, supports the weight of *6 cars at a time.* It was fabricated entirely by *electric arc welding*—with Wilson Machines.

This arc-welding job is but part of a *world-wide* demonstration that, for *versatility*, for *dependability*, for *economy*, the electric arc is unsurpassed. And in this vast demonstration a more dominant part is being played every day by Wilson Machines and Wire — the *pioneer* arc-welding equipment.

No matter what your industry—no matter what your metal-joining problem—you can minimize risks and save money by welding with the electric arc. And you can assure yourself the *maximum* advantages of electric arc welding by using Wilson Machines and Wire—known in practically every industry and in 44 nations for their strong, permanent and homogeneous welds.

*You are invited to consult Wilson Engineers.*



The Wilson Model S Welding Machine shown above is the Type 200 Amperes, one-operator, electric-motor-driven outfit.

WILSON WELDER & METALS CO. INC., 20 WILSON BUILDING, HOBOKEN, N. J.

# WILSON

WELDING MACHINES AND WELDING WIRE

St. Paul Welding & Mfg. Co.
Torchweld Equipment Co.
Weldit Acetylene Co.

**GAS SAVING DEVICES**
Harris Calorific Co.
Weldit Acetylene Co.

**GLOVES (Asbestos)**
Ideal Face Shield Co.
Olympic Glove Co.

**GAUGES**
MotoMeter Gauge & Equipment Corp.

**GENERATORS (Acetylene)**
Air Reduction Sales Co.
Bastian-Blessing Co.
Craftsweld Equipment Co.
Imperial Brass Mfg. Co.
Harris Calorific Co.
Milburn, Alexander, Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Sight Feed Generator Co.

**GOGGLES**
Chicago Eye Shield Co.
Ideal Face Shield Co.
Sellstrom Mfg. Co.
Willson Products, Inc.

**GRINDERS (Portable Electric)**
R. G. Haskins Co.
Stoody Company
N. A. Strand & Co.

**HELMETS (Arc Welding)**
Allan Mfg. & Welding Co.
American Optical Co.
Burke Electric Co.
Central Steel & Wire Co.
Chicago Eye Shield Co.
Electric Arc Cutting & Welding Co.
Fibre-Metal Products Co.
Fusion Welding Corporation
General Electric Co.
Gibb Welding Machines Co.
Hollup Corp.
Ideal Face Shield Co.
Lincoln Electric Co.
Northwestern Mfg. Co.
Owen Electric Mfg. Co.
Quasi-Arc, Incorporated
Sellstrom Mfg. Co.
Waters Welders, Inc.
Westinghouse Elec. & Mfg. Co.
Williams & Co.
Wilson Welder & Metals Co.
Willson Products, Inc.

**HYDROGEN**
Gas Products Association
International Oxygen Co.

**HYDROGEN GENERATING PLANTS**
International Oxygen Co.

**LEAD WELDING UNITS**
Air Reduction Sales Co.
Bastian-Blessing Co.
Craftsweld Equipment Co.
Sellstrom Mfg. Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Kansas City Oxygen Gas Co.
K-G Welding & Cutting Co.
Modern Engineering Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
Victor Welding Equipment Co.
Weldit Acetylene Co.

**LIGHTERS (For Gas Torches)**
Air Reduction Sales Co.
Bastian-Blessing Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Kansas City Oxygen Gas Co.
Milburn, Alexander, Co.
Modern Engineering Co.
Oxweld Acetylene Co.

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Shoot-a-Lite Corporation
Torchweld Equipment Co.

**MANIFOLDS**
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Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Kansas City Oxygen Gas Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
Victor Welding Equipment Co.

**MECHANICALLY OPERATED CUTTING AND WELDING TORCHES**
Air Reduction Sales Co.
General Welding and Equipment Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.

**MOLDING MATERIAL**
See "Fireproof Plastic Material"

**MONEL METAL RODS AND ELECTRODE**
Central Steel & Wire Co.
Wilson Welder & Metals Co.

**NEEDLE VALVES**
Air Reduction Sales Co.
Bastian-Blessing Co.
Harris-Calorific Co.
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International Oxygen Co.
Kansas City Oxygen Gas Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Modern Engineering Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
Victor Welding Equipment Co.

**NITROGEN**
Air Reduction Sales Co.
Gas Products Association
Linde Air Products Co.
International Oxygen Co.

**OXYGEN**
Air Reduction Sales Co.
Gas Products Association
International Oxygen Co.
Kansas City Oxygen Gas Co.
Modern Engineering Co.
Linde Air Products Co.

**PIPE (Iron)**
American Rolling Mill Co.

**PIPE BENDS AND COILS**
Harrisburg Pipe and Pipe Bending Co.

**PLATES (Iron)**
American Rolling Mill Co.
Jos. T. Ryerson & Sons, Inc.

**PORTABLE ARC WELDING OUTFITS (Mounted on Trucks)**
General Electric Company
Goodman Electric Machinery Co.
Electric Arc Cutting & Welding Co.
Fusion Welding Corporation
Lincoln Electric Co.
Northwestern Mfg.Co.
Joseph T. Ryerson & Sons, Inc.
Shrader Electric Company
Wilson Welder & Metals Co.
Westinghouse Elec. & Mfg. Co.

**PREHEATING DEVICES AND OVENS**
Imperial Brass Mfg. Co.
Metal & Thermit Corp.
St. Paul Welding & Mfg. Co.

**REAMERS (Portable Electric)**
R. G. Haskins Co.
N. A. Strand & Co.

**REGULATORS**
Air Reduction Sales Co.
Bastian-Blessing Co.
Craftsweld Equipment Co.
Fusion Welding Corporation
General Welding and Equipment Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Kansas City Oxygen Gas Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Modern Engineering Co.
Oxweld Acetylene Co.
St. Paul Welding & Mfg. Co.
Joseph T. Ryerson & Sons, Inc.
Sight Feed Generator Co.
Stoody Company
Torchweld Equipment Co.
Victor Oxy-Acetylene Equipment Co.
Weldit Acetylene Co.
Williams & Co.

**SCORED CYLINDER REPAIR MATERIALS**
Kansas City Oxygen Gas Co.

**SEAM WELDERS**
See "Electric Resistance Welders"

**SHEETS (Iron)**
American Rolling Mill Co.
Jos. T. Ryerson & Sons, Inc.

**SILVER SOLDER**
Handy & Harman

**SPOT WELDERS**
See "Electric Resistance Welders"

**TANK CONNECTIONS**
Air Reduction Sales Co.
Bastian-Blessing Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
Kansas City Oxygen Gas Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.

**THERMIT WELDING**
Metal & Thermit Corp.

**TORCHES (Welding and Cutting)**
Air Reduction Sales Co.
Craftsweld Equipment Co.
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K-G Welding & Cutting Co.
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**WELDING RODS AND WIRE**
See "Electrodes" and "Acetylene Welding Wire"

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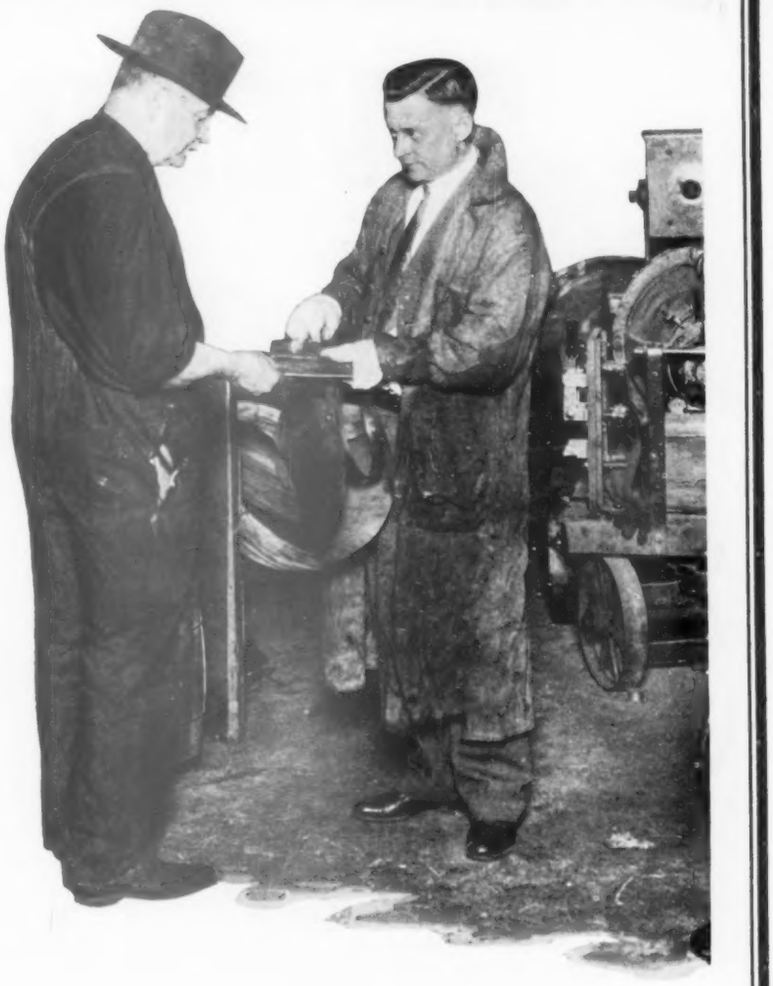
# *Now give it any test you like—*

# *This is a SWEDOX weld.*



**WHEN the SWEDOX man welds a coupon for you, he knows it will satisfy all your tests—because the wire has already been tested.**

**The SWEDOX line which has developed over a period of many years, offers for every kind of welding job a wire or rod which we have proven by test to be the best obtainable for that job.**

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**WELDING RODS, WIRES and ELECTRODES**

ONE OF A SERIES SHOWING AMERICAN TRANSFORMERS IN MANY DIVERSIFIED INDUSTRIES

# WELDING SPEEDS PRODUCTION!

WELDING in the automobile field is an acknowledged success. Leading manufacturers attribute at least two major improvements directly to its introduction in their field:

1. Increased production (with increased profits)
2. Stronger, more rigid chassis, frames and bodies.

The welding equipment for this purpose must be chosen with care. Of special importance is the transformer used, for upon its efficient performance depends the strength of the weld.

Three factors should be given first consideration when choosing the transformer:

1. Efficiency— (wide range of voltage with a dependable control board)
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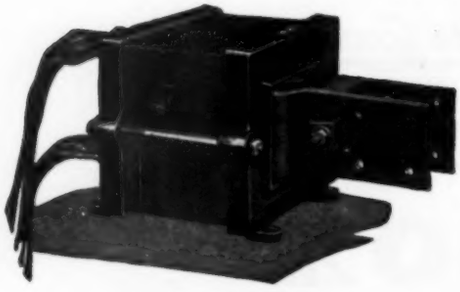
3. Economy — (long life with a minimum of repairs)

American Transformers are built to meet the individual requirements of welding machines for spot, seam, arc, flash and other welding methods. Bulletin 1040-W gives complete description of type CF which is used mainly for spot welding.

There is an American Transformer for every industrial service. Let our engineers advise you on *your* problem—no obligation, of course.



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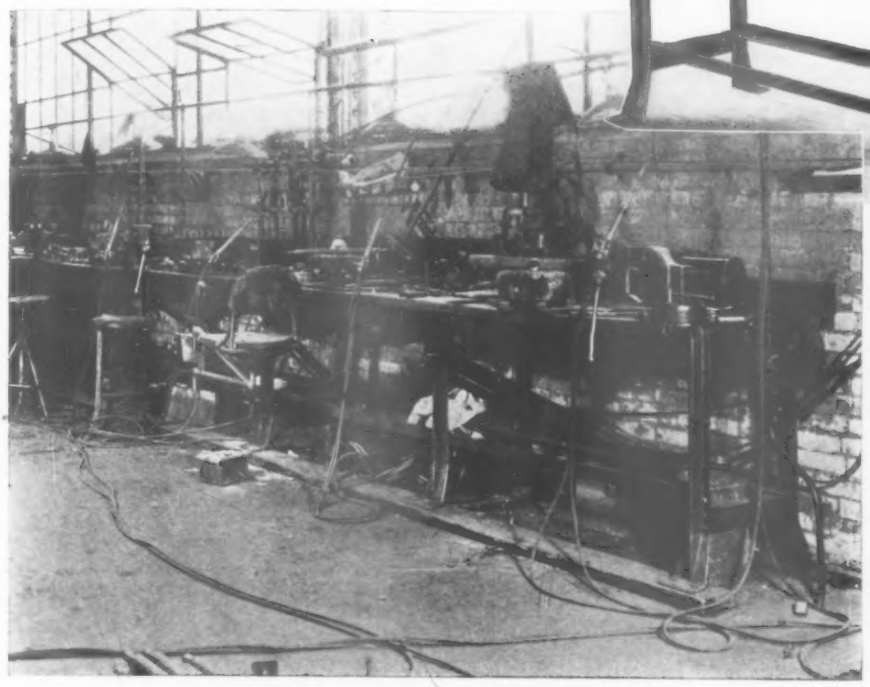

PAT'D AND PAT'S PENDING

**"HALLOWELL" Steel Work-Bench**

Cut above shows details of construction which is identical with that of the "HALLOWELL" in the picture on the left.

**"Hallowell" Welding-Bench of Steel**
**A Recent Installation in an Aeroplane Factory**

For hot work, such as suggested by the many welding-torches in the big picture "HALLOWELL" Steel Benching that can't burn is the very, the only thing.

The Bench Top, Bench Legs, Bench Drawers, are all of "HALLOWELL" Steel Construction, strong and durable; and considering how the bench is littered with all kinds of paraphernalia it certainly needs to be made of stern stuff to stand the racket without splintering, cracking and wearing out in a short time.

But to fully appreciate our "HALLOWELL" Steel Benching Equipment

## Better Get Our Bulletin 386

We carry 1368 combinations of lengths, widths, heights, and weights of "HALLOWELL" Steel Benching in stock for immediate shipment.

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# OWEN INDUCTION ARC WELDER

An entirely new and patented electric welding principle found *only* and *exclusively* in the Owen Welder.

Exhaustive tests and the experience of many enthusiastic users prove that the OWEN INDUCTION ARC WELDER stands supreme as the only electric arc welder embodying all the essential and desirable features necessary in the successful welding of CAST IRON, MALLEABLE IRON, and STEEL products, and at the same time giving to the purchaser the following advantages:

LOWEST FIRST COST
LOWEST OPERATING COST
LOWEST MAINTENANCE COST
VERSATILITY OF PERFORMANCE
SIMPLICITY OF OPERATION

Owen Welders are manufactured in capacities as follows, and are Listed as Standard by the Underwriters Laboratories:

50 to 159 amperes.
50 to 200 amperes.
50 to 300 amperes.
50 to 400 amperes.

To operate from any convenient voltage supply; namely, 110, 220, 440 and 550 volts.

**— Distributors Wanted —**

Address all communications to

OWEN ELECTRIC MANUFACTURING COMPANY
Fayetteville North Carolina

*(Exclusive Manufacturers of the Owen Patented Arc Welding Equipment)*

# It is no longer true

## that all regulators are made on the same principle

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The Underwriters

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OTHERS PENDING
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**STAGE**

**REGULATORS**

**hold the flame CONSTANT. There is no fluctuation because Multi-Stage is built like a compressor and steps the pressure DOWN in TWO STAGES *not* in ONE, the old principle under which all regulators were made. There is but one MULTI-STAGE regulator---investigate.**

*Manufactured by*

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***For demonstration, literature and further information consult nearest "Harris" distributor listed below:***

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## *"Here, Lad—*

If we're going to buy a flock of arc welders, we've got to find out the type that not only helps us out, but helps out the operator as well.

We must watch our step."

## *"No, Pop—*

Let's watch the other fellow's step.
I've just been checking up on the use of arc welders in various industries.
I started in on Pipe Lines for oil companies, as being as fairly recent development, therefore able to watch the other fellow's step.
Here's the census of jobs:

| | | | |
|---|---|---|---|
| A 714 | mile | line | 110 "Stable-Arc" welders |
| 632 | mile | line | 91 "Stable-Arc" welders |
| 125 | mile | line | 48 "Stable-Arc" welders |
| 49 | mile | line | 16 "Stable-Arc" welders |
| 277 | mile | line | 10 "Stable-Arc" welders |
| 157 | mile | line | 10 "Stable-Arc" welders |
| 40 | mile | line | 10 "Stable-Arc" welders |
| 11 | mile | line | 6 "Stable-Arc" welders |
| 205 | mile | line | 6 "Stable-Arc" welders |
| 45 | mile | line | 5 "Stable-Arc" welders |
| 80 | mile | line | 5 "Stable-Arc" welders |
| 50 | mile | line | 5 "Stable-Arc" welders |
| 60 | mile | line | 3 "Stable-Arc" welders |
| 20 | mile | line | 2 "Stable-Arc" welders |
| 9 | mile | line | 2 "Stable-Arc" welders |
| 6 | mile | line | 2 "Stable-Arc" welders |

The reason for this marked preference is that the Lincoln is the machine that gives the operator the speed he needs to keep production in step. So that the only steps we need to watch are the fast ones of competition."

**The Lincoln Electric Co.**
**Dept. No. 27-10, Cleveland, O.**

W-116

***The Lincoln "Stable-Arc" Welder***

**— welds easier**
**— makes better welds**
**— permits greater output**

**because of the steady uniform arc throughout entire welding range, which is the result of:**

**Variable voltage design**
**Laminated magnetic circuit**
**Separately-excited generator field**
**Double control of welding heat**
**All steel construction**

***No other welder has all these features.***

**LINCOLN "Stable-Arc" WELDER**

# BETTER WELDS 33⅓% to 50% LESS

**Stronger welds . . . Welds with exceptionally high resistance to corrosion . . . welds that can be made without overheating and consequent weakening of the base metals.**

**Those are a few of the advantages you gain when you start using**

## *Quasi-Arc* ELECTRODES

**They are scientifically designed to produce welds that stand up under severe service. They are supplied in standard 18 in. lengths with cores of varying diameters, and composition suited for the work to be done, as follows:**

**Mild Steel** Electrodes (Colored Blue)—Suitable for general welding of iron or mild steel, structural steel and plate construction, wheel tires, filling steel castings, etc.

**Overhead** Electrodes (Colored White)—Suitable for any overhead or vertical welding.

**Uranium** Electrodes (Colored Brown Ends)—Suitable for boiler welding and other work subject to stresses at high temperatures. Such welded joints also show a remarkably high resistance to shock, fatigue and vibratory stresses. Give satisfactory results in joining stainless steel with mild steel, and produce joints of high efficiency in welding high-carbon steel.

**Electrodes** for Cast Iron (Colored Yellow)—Suitable for the repair of iron castings, leaving a soft machinable deposit.

**Carbon Steel** Electrodes (Colored Red)—Suitable for reinforcing worn parts of machinery, building up teeth of steel gear wheels, reinforcing steel wobbler ends for rolling mills, trolley rail treads, etc.

**Manganese Steel** Electrodes (Colored Black Ends)—Suitable for reinforcing or building up manganese steel crusher jaws, dredger bucket lips, trolley crossings, etc.

**Vanadium Steel** Electrodes (Colored Dark Gray Ends)—Suitable for building up gear wheels, crank-shafts, axles, etc., which may require case hardening.

**Stainless Steel** Electrodes (Colored Blue Ends)—Suitable for welding stainless steel and for reinforcing other steels with stainless steel.

Convincing evidence for those who want it—

*Let Us PROVE QUASI-ARC Superiority in Your Own Shop on Your Own Type of Work*

**For sixteen years, in every part of the world, on every class of work from a simple repair job to such particular work as fabricating the world's first rivetless ship, Quasi-Arc Electrodes have been making their record and demonstrating their superiority. Let us SHOW YOU in your own shop. The records are open to you and so convincing you will be glad to standardize on Quasi-Arc because the advantages are too manifest and important to forego. Proof awaits—ready when you are.**

## QUASI-ARC, INCORPORATED

**11 West 42nd Street, New York, N. Y.**

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# The Most Popular ARC WELDER ON THE MARKET

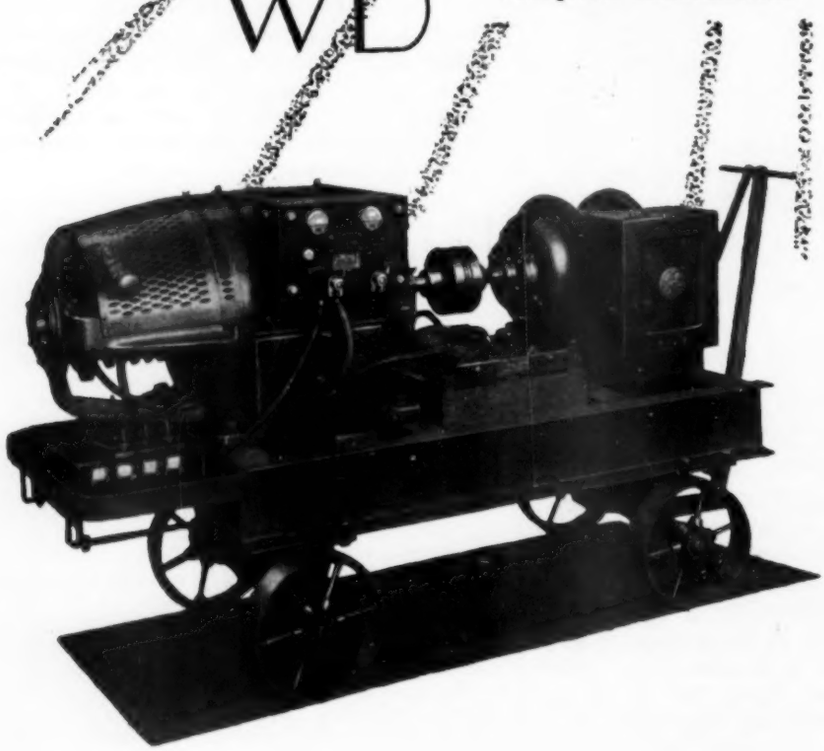
THE MORE YOU ARC WELD THE MORE YOU SAVE

It'sthe simplest, most substantial, and best-looking set built. Liberal use of high-grade materials, fine workmanship, and good design—inherent in all G-E products—are apparent at a glance. It is a self-excited set—that means no separate exciter to look after.

No other arc welder excels it in speed of welding or deposition of metal. Infinitely small gradations of welding current can be obtained simply by turning a handle. It is extremely easy to operate and will give 24-hour service day after day. And we back our reputation against its ability to meet N.E.M.A. and N.E.L.A. ratings—at any time.

A call to your nearest G-E office will bring you complete information.

TYPE WD

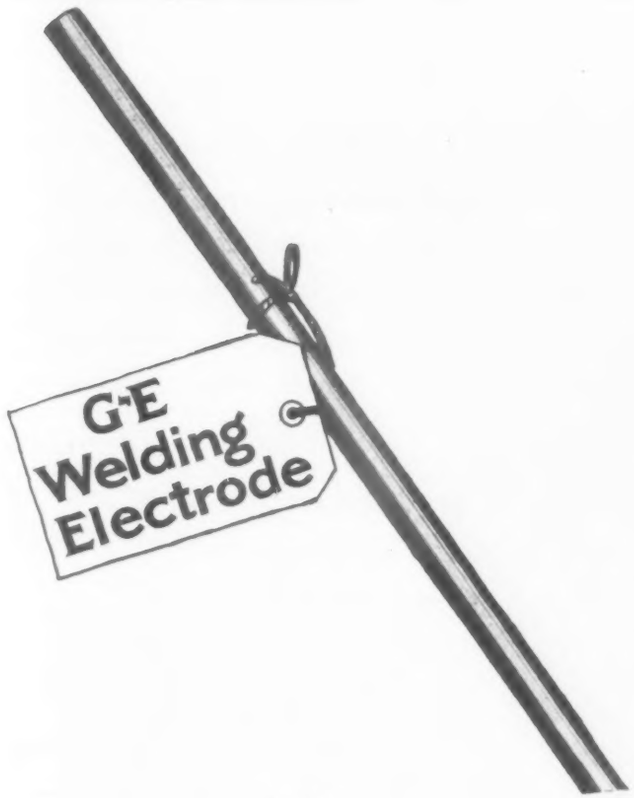


G-E welding electrodes—when used with Type WD arc welders—produce strong, smooth welds at great speed.

530-58

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

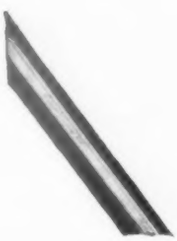


# -*for* welds to withstand pressure

A leading utility company recently constructed three 30,000-gallon storage tanks. The 1600 feet of welded seams in each of these huge water bins must withstand tremendous pressures. It is significant that G-E Type "F" welding electrode was chosen for this exacting assignment.

The selection of Type "F" electrode was not a haphazard choice. It had approved itself to this company in the shops and in the field. Whether applied in vertical, horizontal, or overhead positions, the welds have been tough and durable. Whether used for heavy structural steel or pressure pipe-line welding, the unions have been strong and lasting.

For prompt service or additional information as to various types of G-E electrodes, get in touch with the G-E Welding Electrode Distributor near you or write to Section E-5310, Merchandise Department, General Electric Company, Bridgeport, Connecticut.



For simplicity, reliability, and ease of operation, G-E arc-welding sets are unequalled. They are available in all sizes, all types—for either hand or automatic operation—for one or more operators.

550-509

JOIN US IN THE GENERAL ELECTRIC HOUR, BROADCAST EVERY SATURDAY AT 9 P.M., E.S.T. ON A NATION-WIDE N.B.C. NETWORK

GENERAL ELECTRIC

MERCHANDISE DEPARTMENT, BRIDGEPORT, CONNECTICUT

PROGRESSIVE shop superintendents realize the economy in the use of the various welding processes to replace broken machine parts, and thus reduce annoying and expensive "shut downs."

The strength of a weld depends primarily upon the quality of welding wire used. The development of Roebling Wire for Welding has been coincident with the development of the welding industry.

Its absolute uniformity throughout all shipments and its easy flowing quality recommend it to every welder. If you are not using Roebling Welding Wire, it amply merits your consideration.

Samples for demonstration will gladly be sent upon request.

*Write for catalog A-529*

# Roebling
## Welding Wire

John A. Roeblings
Sons Company
Trenton,
New Jersey,
Makers of
Wire Rope
and Wire

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## "the greatest abrasive resistance of any hard facing metal"

FOR tools and parts subjected to great abrasion, neither industry nor science has yet discovered the equal of STOODITE.

This super-hard surfacing metal is *so easily* applied with either the acetylene torch or electric arc, and, once on *it stays*... and wears... and wears... and wears!!!

Write for descriptive literature.

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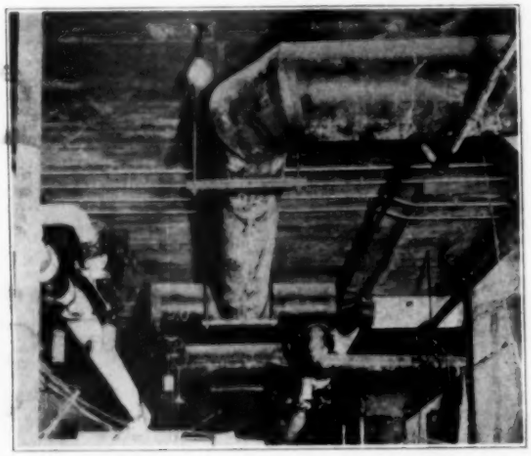
*Manufacturers of* WELDING ROD • ALLOY STEELS • EQUIPMENT

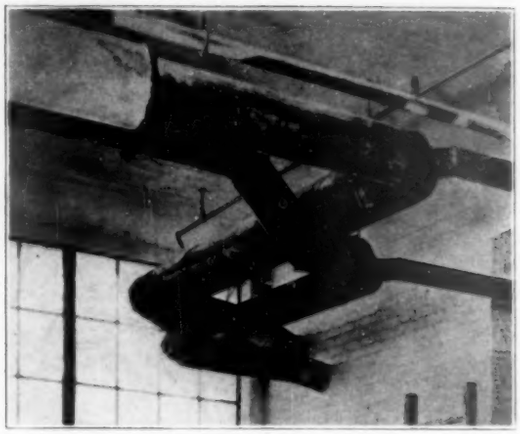
WHITTIER, CALIFORNIA

# Every Day It Is Saving Thousands of Dollars For Builders

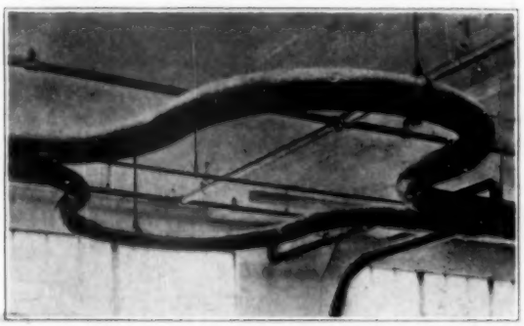
## NORTH — SOUTH — EAST — WEST



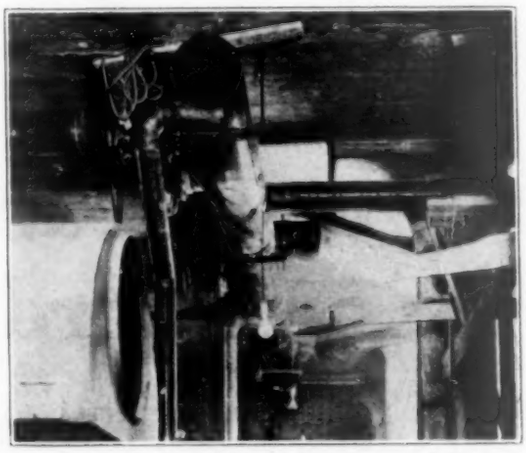
*Complicated Condenser Assembly Is Simplified by Welding the Joints*



*Welding Makes Impressive Savings in Cost and Weight in This Complicated Assembly*



*Strains Set Up by Temperature Changes Are Easily Handled With the Welded Expansion Bend*



*Welded 20-Inch High Pressure Steam Header*

If you are not familiar with the saving and greater efficiency of gas welding and cutting of pipe in building construction—ask a member of the Gas Products Association for information and a demonstration—or address the Association at 608 South Dearborn Street, Chicago.

# "Three Generations of Brass Making"
## Do Make a Difference in the Finished Product

**Mueller**
WELDING
BRONZE ROD

**Mueller**
*Makes*

Red Tip Brass Rod
Brass and Copper Forgings
Nickel Silver Rod and Forgings
Tuf-Stuf Rod and Forgings
(*Corrosion Resisting Metal*)
Brass Castings
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Mueller Blue Tip Bronze Rod
Brass and Copper Seamless Tubing
Mueller Blue Tip Bronze Welding Rod
"600" Bearing Metal
Airplane Fittings
Electric Refrigeration Valves and Fittings

IF you have never used Mueller Welding Bronze Rod you are overlooking a product that will enable you to do better work and to do it in less time.

Quality isn't left to chance in Mueller manufacture. Careful analysis of each heat as it is poured insures a uniform product.

Mueller Welding Bronze Rod makes sound, strong, non-porous welds. It flows evenly and freely. Absence of porosity eliminates sputtering and explosions.

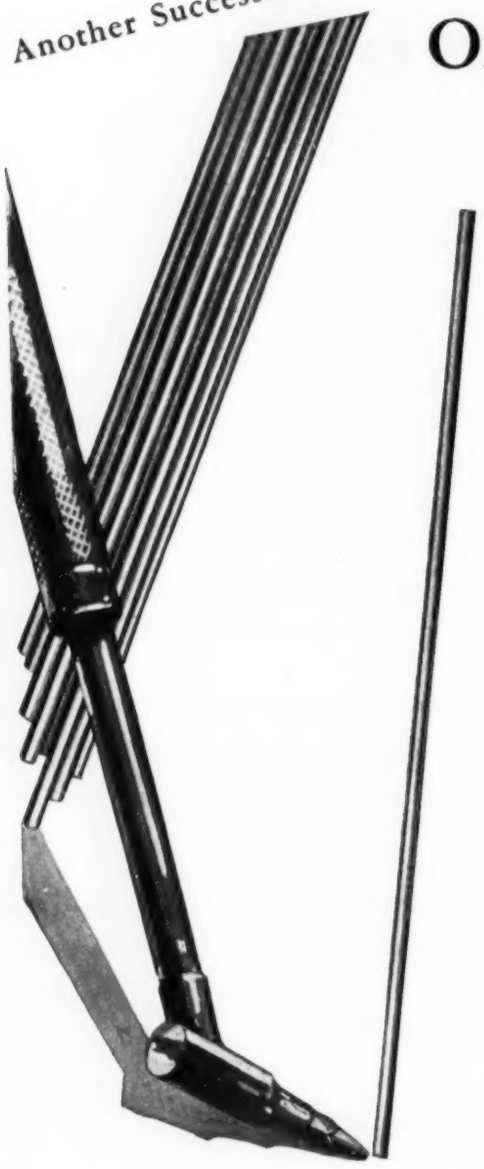
Find out for yourself the Quality of Mueller Welding Bronze Rod. We'll gladly mail you a generous sample free. Drop us a line with your address, we'll do the rest.

**Mueller Brass Co.**
PORT HURON MICHIGAN
DETROIT DISTRICT

# Mueller Brass
THREE GENERATIONS OF BRASS MAKING

# *Introducing*

Another Successful Union Carbide and Carbon Research Laboratories Development



## Oxweld No. 21 High Strength Bronze Welding Rod

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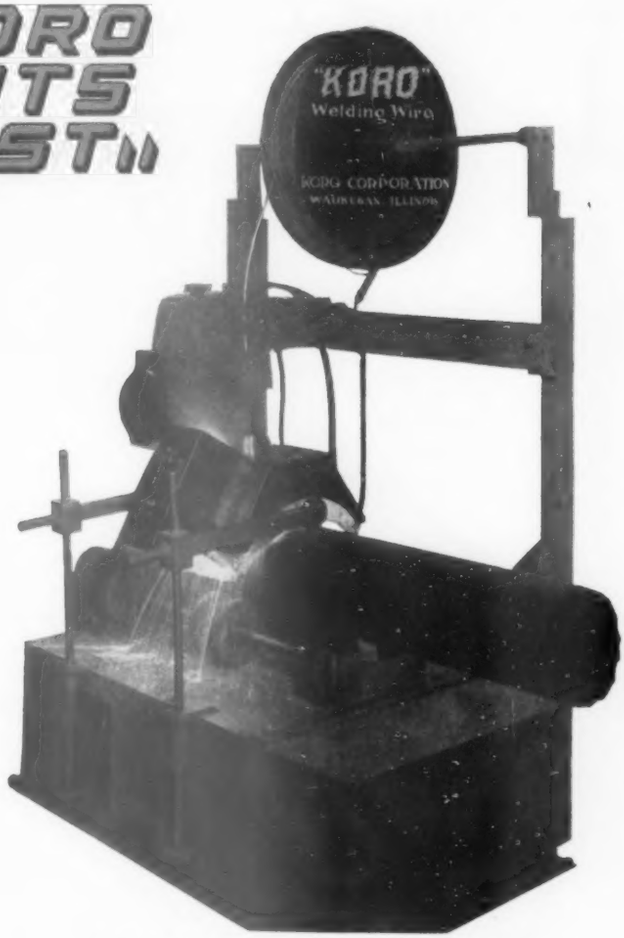


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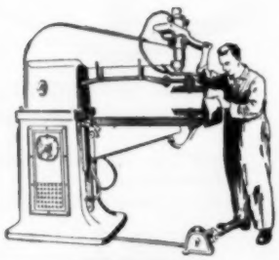

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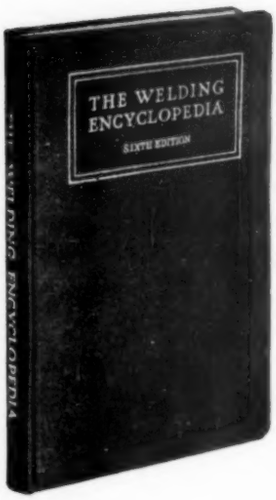


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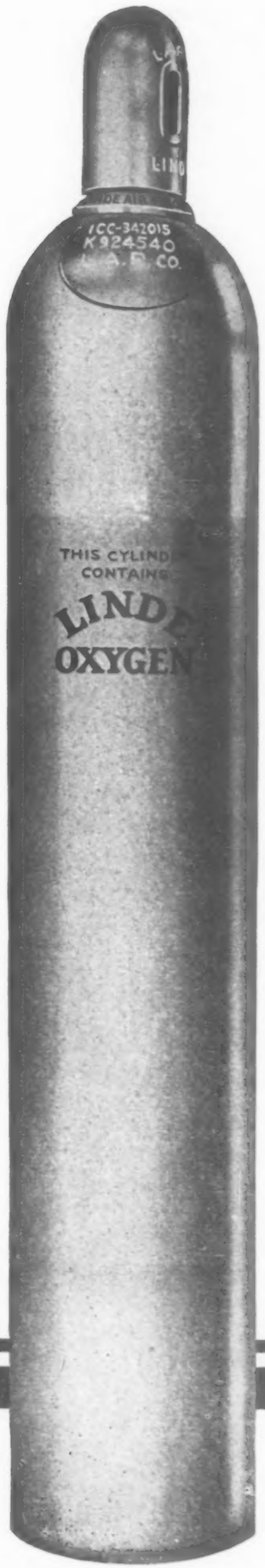


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# EDITORIAL

## Does It Pay?

ACADEMIC instruction in the fusion welding processes has during the past few years been included to a limited extent in the training given in a few of our prominent engineering schools, so the beginning of this movement may be said to be well under way. There are indications, however, that the movement is on the verge of spreading rapidly, so that it will not be long before all engineering schools teach their students what these processes are and how they may be best used by the engineer. No other activity could be more helpful to the progress of welding, because the lack of understanding of welding by trained engineers in the past has prevented its acceptance on many construction projects for which it is admirably adapted. This recognition of the importance of welding by the higher institutions of learning is so significant that it is worthwhile to consider it a little, and think of some of the activities which have paved the way for the progress of welding in colleges and universities. There can be no doubt that the principal reason for this progress is the vast amount of welding which is being done as compared to what was done fifteen years ago and the consequent fact that engineers throughout the metal fabricating industry are so dependent upon these processes in present day practice that their education is obviously incomplete unless it includes the proper kind of welding knowledge. Back of this industrial acceptance of welding are the tireless efforts of the advertising and publicity departments of our industry. Their activities have assumed huge proportions. For example, there are now being published monthly house organs by manufacturers and dealers totaling in the neighborhood of 150,000 copies per month. Large display advertising of leading companies in trade and technical publications are advertising welding monthly at a rate which is estimated to reach about 500,000 readers. Engineers of these companies are supplying articles to the technical press and such articles are regularly appearing in papers reaching at least 400,000 readers per month. To this must be added some splendid work which has been done by supplying speakers for meetings of trade and technical organizations. The figures given are probably conservative estimates, and it would be a tremendous task to compile the exact statistics. To these activities may be added those of one trade journel devoted to oxy-acetylene welding which has been promoting the interests of that process for about thirty years with a monthly distribution ranging from three to five thousand and the activities of *The Welding Engineer* for the past fifteen years, distribution often being in the excess of five thousand monthly, and our little publication called The Welding Shop devoted entirely to the promotion of the welding idea, whose distribution has varied from 10,000 to 26,000 copies. Then, there is *The Welding Encyclopedia* of which over 40,000 copies have been sold. The miscellaneous distribution of bulletins, instruction books and other material of an educational nature would probably be amazing if the total could be reached. *The Welding Engineer* has prepared for manufacturers approximately 164,000 reprints from its pages during the past twelve months. One interesting item of this collection indicates 15,000 reprints of an article on pipe welding supplied without cost to twenty-seven welding equipment dealers for distribution to their prospects in the heating and piping fields. These figures are impressive. They show that the present day promotion of the value of the welding process to industry is an activity not to be figured in thousands, but in hundreds of thousands. Furthermore, they show the faith which these advertising and publicity directors have in the process and the products which they have to sell. The continued progress of welding show conclusively that it has the merit which makes continued advertising possible and also shows that the advertising men in this industry have justified the expenditures which they have asked their directors to authorize. They have done a splendid job of paving the way for rapid progress in the future. There is no doubt that this progress will be made. The lion's share of credit for this progress must be given to the foresight and merchandising ability of these organizations which have spread the gospel of good welding over such a wide area and to such a decidedly good advantage. They have proven that it pays to advertise and especially that it pays to advertise welding. Further proof will be written in the expansion of our industry which is bound to take place in the next few years.

---

## Thank You, Cleveland

ONE memory which the exhibitors at the National Metal Exposition in Cleveland have carried away with them is that the local welding group and particularly the members of the Cleveland Section of the American Welding Society left nothing undone in the way of hospitality. Their cooperation with the exhibitors was not only splendid but most thorough, and it meant a lot to our manufacturer friends to be taken care of so carefully and so efficiently. The men who had charge of the arrangements, the entertainment and the banquet did a job of which they may well be proud. The success of the whole program at Cleveland reflects a great deal of credit on the American Welding Society but it could not be done without the whole hearted desire on the part of several individuals to do the job right. There is no reason why every visitor at the show and at the other events should not have returned home with a warm spot in his heart for Cleveland.

---

## They Are Not Up-to-Date

CIRCULATION men like to make use of the illustration that the man who has no time to read his trade paper is like a wood chopper who is so busy that he hasn't time to sharpen his axe and there are plenty who are really behind the times in their methods because they do not keep informed. For example, a writer of one prominent technical magazine describes with considerable detail the method of repairing a heavy iron casting. A considerable amount of labor was involved and the whole reclamation job was a mechanical repair instead of the weld which might have been used, and the equipment effected by the failure was out of service for seventeen hours. If this man had read the advertising pages of his trade paper he would have known that this whole job could have been done in about three hours by bronze welding at a fraction of the cost of making a mechanical brace for the broken parts. Some plant executives seem to have an impression that a piece of welding apparatus is good for only one purpose. However, there are so many uses for welding that every plant should have in its organization one man whose duty it would be to keep informed on all the possibilities of welding and see that the process is used whenever it is economical to use it. Knowing how to do one welding job is a very long way from knowing all about welding.

# Welding with MAURATH Electrodes *played an important part in this architectural achievement*

THE new Chrysler Building, New York City, is reputed to be the tallest building in the world. The store front, grill work, window sashes, interior trim and the complete covering of the seven top floors of the tower are all Krupp Nirosta steel. This new alloy was specified for exterior and interior metal decoration in order to secure extraordinary beauty and a finish permanently lustrous and clean in the face of the corrosive action of atmosphere, smoke, and gas. Maintenance expense is eliminated because there is no need of polishing, replacement or refinishing.

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Nirosta Steel is produced by the following firms:

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**Cleveland Alloys Co., Cleveland, Ohio,**

all of whom use and endorse MAURATH Electrodes for welding Nirosta Steel.

MAURATH Electrodes make it possible to weld all corrosion resisting metals, producing welds identical with the parent metal.

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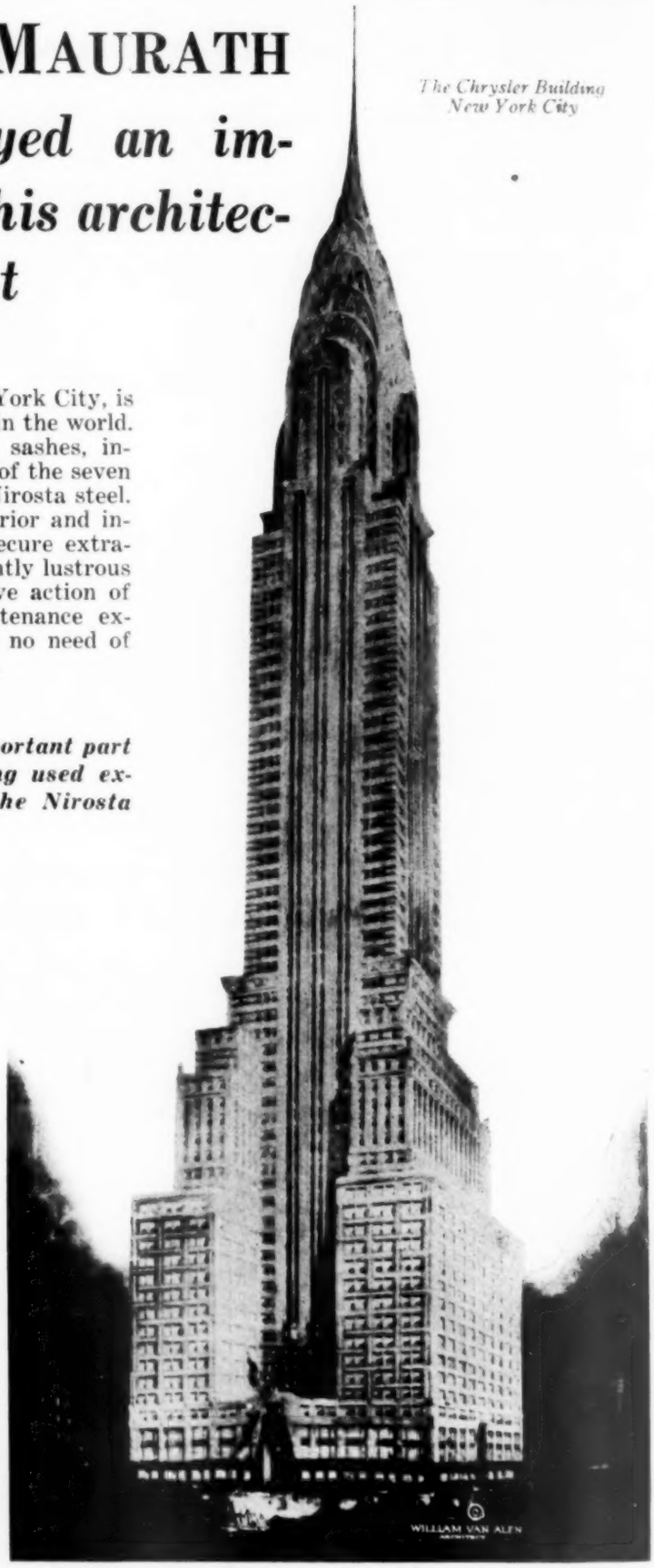


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# Welded Loading Coil Cases

## Welded Steel Cases Replace Iron Castings with Advantages of Weight Reduction Lower, Manufacturing Costs and Better Production Schedules

AMONG the larger manufacturing plants which have substituted welded products for castings is The Western Electric Company, Chicago, Illinois. In an article in a recent issue of the Western Electric News, Mr. C. B. Evans of the Manufacturing Development Branch at the Hawthorne Plant describes changes made in the manufacture of loading coil cases.

The application of the electric arc welding process has enabled the company to replace the familiar cast iron loading coil case with a new case made from sheet steel. (Fig. 1) For years loading coil cases have been cast from high grade grey iron in the foundry at the Hawthorne plant, and their manufacture has required the greatest care and skill to insure a satisfactory product. Considerable machining was required to provide a tight gasket joint when the cover was assembled to the case. Another factor promoting the new design was the large increase in the demand for loading coils during the past year. Production of cast cases to meet the demand would have required over half of the entire foundry capacity.

The sheet steel design required radically new manufacturing facilities. Shearing, bending, and arc welding equipment was purchased and fixtures and tools were developed with the result that cases weighing less than one half as much as the cast iron design are now being made from steel plates at a considerable saving.

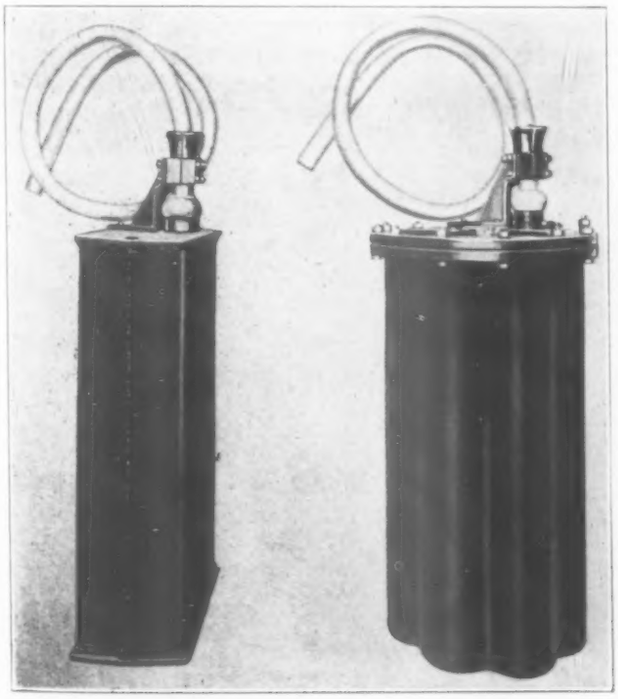


Fig. 1. **Right: the Welded Sheet Steel Loading Coil Case. Left: the Old Type Cast Iron Case.**

These cases vary extensively in size. They range from 1 ft. 5 in. by 11 in. to 1 ft. 10 in. by 1 ft. 4 in. in cross section, and from 2 feet to 4 feet in height. The top and bottom plates are made of 5/8 in. material and the shell is made of the 1/8 in. stock.

In the first manufacturing operations the sheets of steel received from the mill are trimmed and bevelled in preparation for welding. A gate type shear, 8½ feet high, 8 feet long, and weighing 12½ tons is used for this work. This machine is driven by a 25 horsepower motor and is capable of shearing a steel plate ¾ in. thick and 6 feet long in less than 3 seconds. The cutting is done by a blade mounted in a casting which weighs nearly a ton.

The second operation, that of forming the two channels which make up the body, is performed on the press brake shown in Figure 2. This machine is ten feet high, ten feet long, and weighs about 12 tons. To form a channel the operator lays one of the plates on a "V" block below the

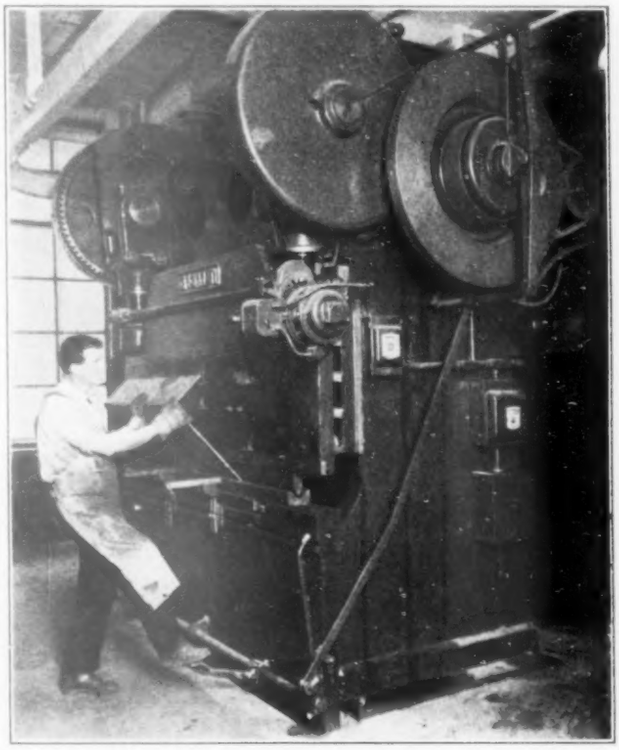


Fig. 2. **The Press Brake Used to Form Up the Two Channels Which Make up the Body of the Case.**

ram and steps on the treadle. The ram descends and bends one end of the plate into a right angle in about three seconds. The plate is then reversed, and the opposite end is bent in the same manner.

The first welding operation is performed on the automatic machine. Two channels are mounted on a swinging beam with the joint under the automatic welding heads. A length of fire hose inside the beam is then expanded by means of compressed air. The expansion of this hose, which might be likened to the inner tube of an automobile tire, clamps the channels firmly in place for welding. Two motor driven welding heads move along the channels automatically when the current is turned on. An extensive electrical control mechanism governs the speed and the feeding of the wire at the proper rate to maintain the correct length of arc. The first head deposits a bead of metal at the bottom of the joint and the second head follows and deposits additional metal which fills the joint, incidentally annealing and improving the metal deposited by the first head. Figure 3

shows this machine in operation. The longitudinal seam welded here is a butt joint, and in making it no special pro-

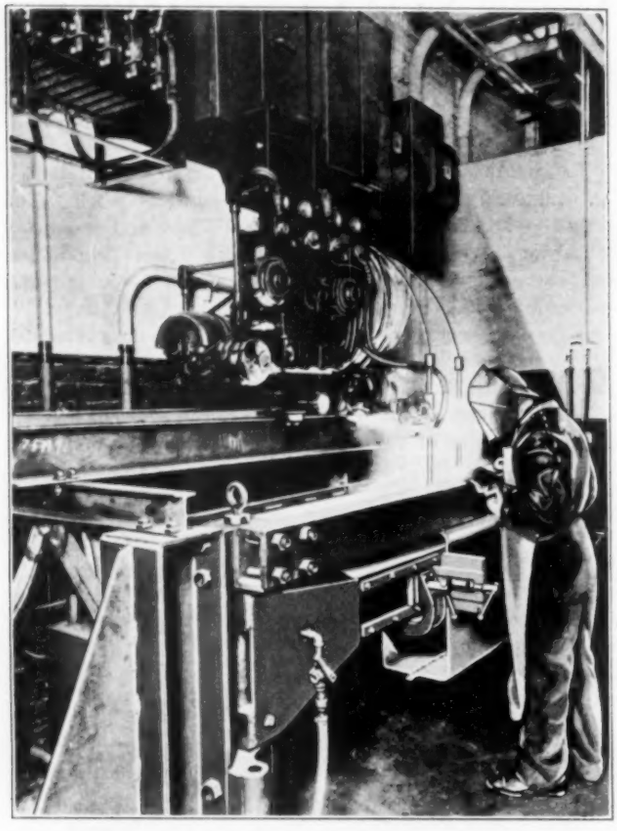


Fig. 3. The Automatic Welding Machine Which Welds the Side Seam of the Case.

vision outside of that in the jig is made for expansion. In all there are a total of approximately 33 lineal feet of welding in a representative case.

The bottom plate and the small details are then welded to the body in successive operations by the semi-automatic welding unit shown in Figure 4. Each welding unit is enclosed in a separate room and the operators are equipped with complete outfits of protective clothing, leather gloves, goggles and special helmets. Six of these semi-automatic

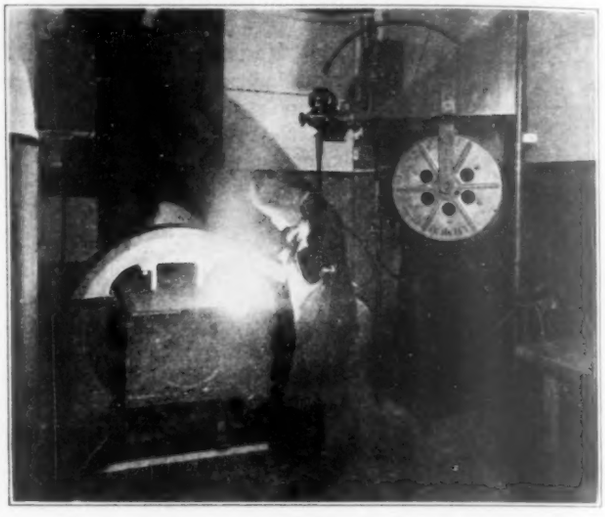


Fig. 4. The Semi-automatic Machine Used in Welding on the Bottom and Other Parts.

welding machines are used in this work, and three hand welding sets are used for welding on the brackets, etc. The current for all this welding work is supplied by three machines, two of which produce a 60 volt, 1,000 ampere current each, and a third new motor generator producing a 60 volt, 2,000 ampere current. This latter is one of the largest in use anywhere. It is a G. E. machine driven by a 180 horsepower motor at a speed of 1,200 revolutions per minute. When it was installed it was necessary to double the bus bar equipment to carry the additional current. Bus bars are used

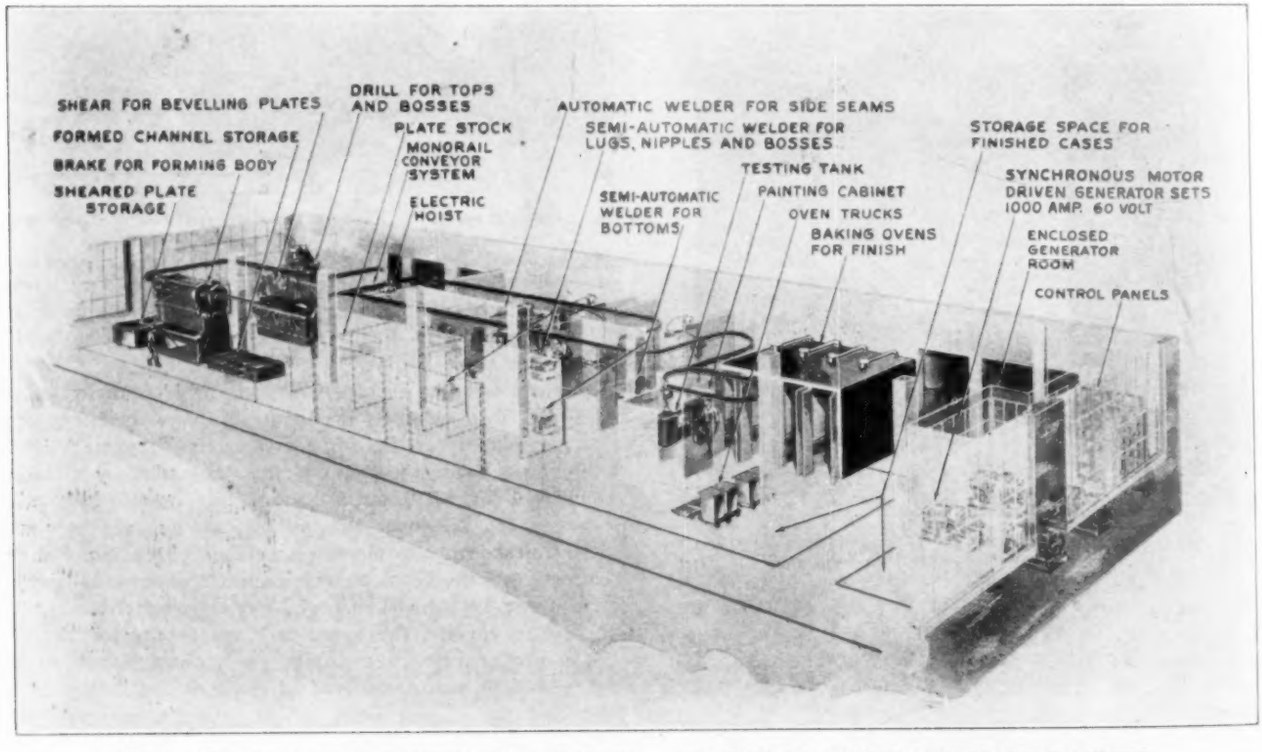



Fig. 6. Diagram of the Arrangement of the Equipment. The Straight Line Method of Manufacture Is Followed.

instead of cable because the low voltage and high current used in welding necessitates a minimum of resistance in the conductor, and a cable of comparable size would be unsatisfactory in other respects.

After being welded the case passes to the testing tank shown in Figure 5, where it is pressure tested under water

**Fig. 5. The Welded Case Being Tested and Inspected.**

to indicate the presence of the smallest leak. Following the testing operation the case is painted with an iron oxide paint. After painting, the cases are baked for two hours in an oven. In this process air is heated by a gas flame, brought in direct contact with the cases, and recirculated through the burner to attain the greatest possible operating economy.

The completed case is next filled with loading coils, after which the cover is welded on with a semi-automatic unit. A second air and water test is then made to insure the final quality, a protective coat of Brewster Green paint is applied and the case is ready for shipment.

The arrangement of the equipment is shown in Figure 6. The layout of machines has been carefully planned to facilitate the movement of the product, to minimize the amount of handling required, and to reduce the quantity of the material in the process. The straight line method of manufacture was adopted, with operations following one another in close sequence. The cases are handled throughout the entire process by means of electric hoists travelling on an overhead monorail system.

An impressive quantity of raw material will be fabricated annually in the relatively small area of 6,000 square feet occupied by the equipment described. Over 1,500 tons of sheet steel and approximately 75 tons of welding wire will be required each year.

## WELDED BATTLEDECK FLOOR SAVES $10,000 ON BRIDGE

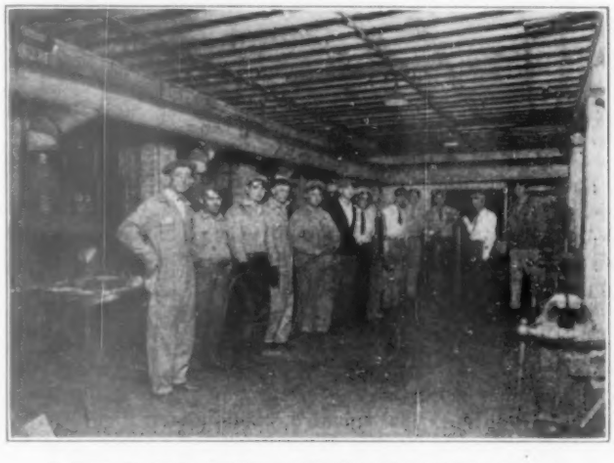
In a paper on the trend in modern steel bridge design read by F. H. Frankland, Director of Engineering Service, American Institute of Steel Construction, before the Sixteenth Annual Convention of the Canadian Good Roads Association, September 18, at Charlottetown, Prince Edward Island, it was pointed out that the new steel plate floor, developed by the American Institute of Steel Construction, and known as the Battledeck Floor, finds a wide use in the economic design of highway bridges. By this system steel plates are welded to the stringers over their webs and their end edges over the transverse floor beams, so that the plate deck is truly continuous in both directions, the stringers and steel plate thus forming a T beam, with the neutral axis of the combined section close up under the top flanges of the stringer beams.

An example of the application of this system to bridges is a 150 foot span swing bridge recently designed by the Alabama State Highway Department. The stringer spacing is 18 inches and a one-half inch plate will be welded to these over their webs. The plans call for the plates to be 6 feet wide in long lengths, spliced with a welded batten plate. As some of these plates would be 70 feet with an area of 420 square feet—individual plates weighing some four tons, it is obvious that they would be too unwieldy to handle in the field, consequently the drawings now have a note on them which permits the fabricator to detail the plates in such lengths as to make their handling economical. By placing the plate end-welds over each transverse floor beam the maximum weight of plate is kept around one thousand pounds. The Highway Department's bridge engineers made a series of economic comparisons between this design and others based on the usual types of construction, with the result that a saving of over $10,000 was indicated.

Various wearing surfaces may be applied to Battledeck Bridge Floor construction—either a non-skid surface plate may be used; asphalt paving block one and one-half inch thick, as used in this Alabama bridge; asphalt laid in the usual way directly on the plates and of any required thickness, or wood block laid in asphaltic mastic.

## BRADLEY POLYTECH HAS COURSE IN PIPE WELDING

Bradley Polytechnic Institute, located at Peoria, Illinois, is one of the technical schools which has recently established complete instruction courses for the training of gas welders. This is the first year that welding instruction has been given and the feature of the work was a special course in pipe welding, which was attended largely by union pipe fitters. The course covered twelve weeks and consisted of two nightly



**A Class in Pipe Welding at Bradley Polytechnic Institute.**

periods per week, each period lasting two hours. In addition to the general welding information, special attention was given to the welding of pipe up to 12 inches in diameter. Instruction was also given in the cutting and welding of pipe for Tees, Ells, Ys and headers. The instructor is Mr. F. P. Coe, who is not only an experienced welder but has also had a number of years' experience in the service departments of welding equipment manufacturers. The accompanying illustration shows the first class which was trained at the Bradley school.

# Gas Welding Aluminum*

## Welding Properties of Aluminum and Its Alloys—Importance of Flux—Procedure for Welding Sheets and Castings

By W. A. Dunlap†

ALUMINUM and aluminium alloys have become a very important material of construction and fabrication in many branches of modern industry, and this has necessitated the development and perfection of welding processes adaptable to this metal. The Aluminum Company of American has naturally taken a leading part in the development of these processes, and the purpose of this paper is to tell you something of the art as it is practiced today in the plants of this company.

### Fusion Welding

Among the methods which are employed for joining aluminum or its alloys, none is more generally satisfactory than fusion welding with the oxy-hydrogen or oxy-acetylene torch. In the hands of an experienced aluminum welder the process is simple and rapid, and it can be applied to metal of all thicknesses. The resultant joint is not unsightly, and if necessary the weld can be finished off in such a way that it is impossible to detect where the joint exists.

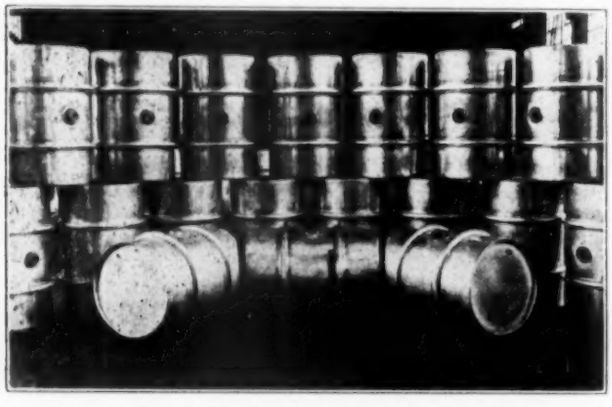


**Fig. 1. Welded Aluminum Acid Drums.**

Some training is necessary before a welder can turn out consistently reliable results with aluminum. This metal has distinct characteristics of its own which involve a somewhat different technique from that required with steel, cast iron and other metals.

Torch welding is applicable both to the manufacture of articles from sheet aluminum and to the repair of aluminum alloy castings. In these two applications, the methods of working are generally the same, though the difference in physical properties may involve slight modifications. Aluminum alloy castings being more brittle than pure aluminum sheet, the danger of cracking due to expansion and contraction effects is more serious; on the other hand, pure aluminum sheets are normally much thinner than aluminum castings and hence require a more delicate handling of the torch. For both classes of material certain precautions are necessary if reliable welds are to be obtained.

### Welding Apparatus

The apparatus required for welding aluminum is the same as that required for welding other metals, and it consists essentially of a supply of oxygen and some combustible gas such as hydrogen or acetylene, together with reducing valves, safety valves, torch, and a supply of different sized tips. The selection of the correct size of tip for any particular work is largely a matter of experience. The size of the tip must depend greatly upon the shape and size of the object to be welded, as well as upon the thickness. The welding of a large tank of aluminum will require a larger tip than the welding of a small piece of bar of equal thickness, because

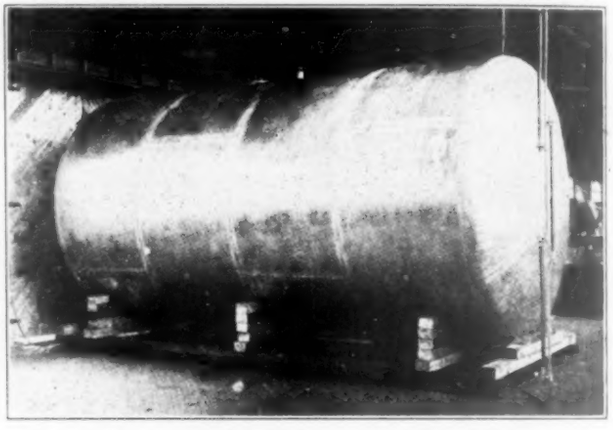


**Fig. 2. Welded Aluminum Storage Tank.**

the larger article has a much greater capacity for heat and a larger radiating surface. Much of the heat applied to the edges of the metal to be welded escapes by conduction to remote parts of the object, where it is absorbed in raising the temperature, and part of the heat is radiated away to the air. The tip must be of sufficient size to melt the edges in spite of this continuous draining away of heat. The size of the tip will also depend to some extent upon the skill of the welder; a quick welder will be able to use a large tip which in the hands of a less experienced and slower man, would result in overheating and the formation of holes.

### Flame

In welding aluminum and its alloys it is preferable to use an oxy-hydrogen flame whenever it will supply sufficient heat for the job at hand. A slightly larger tip is used for hydrogen than for acetylene on a given gauge of sheet.

The main reason that hydrogen is superior to acetylene and natural gas for welding aluminum is that the latter two tend to deposit soot or carbon on the metal, thus interfering with the removal of the oxide film by the flux used in welding. Carbon, being a very inert material, protects the oxide film from the action of the flux until the soot is actually burned off by the continued action of the flame. In this way the coalescence of the metals is delayed and a tendency induced for overheating the weld. It has been demonstrated by means of tensile tests of welds that a higher percentage of perfect welds can be made with hydrogen than with acetylene. Microscopic examination of welded tensile strength specimens of commercially pure aluminum which break through the center of the weld usually shows an imperfect weld due to voids and dross inclusions. The low tensile strength of such specimens

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†Metallurgical Division, Research Bureau, Aluminum Company of America.

is also an indication of imperfect welds. In this investigation 30 percent of the acetylene tensile strength specimens broke through the center of the welds in comparison with only two percent for the hydrogen welds.

Whether using hydrogen or acetylene, the torch should be carefully adjusted so as to give a neutral flame. This gives the best speed and economy, as well as a cleaner and sounder weld.

### Flux

All aluminum is coated with a thin film of aluminum oxide which prevents the easy coalescing of the two surfaces of molten metal. The production of a sound weld in aluminum necessitates the removal of this obstructing oxide film. Aluminum oxide is so refractory and tenacious that it can only be removed from the welding zone by mechanical means or by

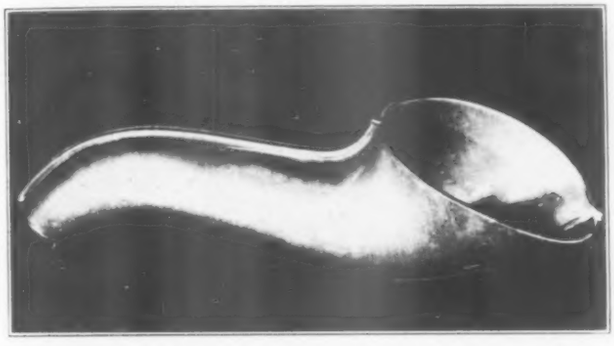


**Fig. 3. Tea Kettle Spout Formed from 0.051 Inch Aluminum Sheet Flanged for Welding.**

the action of a flux. Mechanical methods are very awkward and ineffective, and it was not until the flux method of welding aluminum was introduced that much progress was made in the welding of this metal. At the present time, however, this operation is in a high state of perfection, and people not familiar with it are amazed at the ease with which aluminum structures are repaired and assembled by the hands of well-trained welders.

A satisfactory way to use flux is to mix it with water to the consistency of a thin paste. A day's supply of the flux paste should be made up each morning. If any is left in the container over night it should be broken up and thoroughly stirred the next morning, as it has a tendency to crystallize and lump upon standing. Most aluminum fluxes are slightly hygroscopic, therefore, the container for the dry flux should be kept tightly closed to prevent decomposition. The flux paste may be applied to the seam to be welded by means of a brush. However, if a welding wire or rod is being used, the most convenient method is to dip the wire or rod into the flux paste just prior to welding. The coating of flux on the wire dries and melts in the heat of the torch, running down onto the work and flowing along seam ahead of the torch flame, removing the oxide film as it goes. This leaves the metal in an absolutely clean condition, so that when it melts the parts readily coalesce.

### Welding Wire

Commercially pure aluminum (2S) and the aluminum-manganese alloy (3S) should ordinarily be welded with pure aluminum wire. However, in cases where the parts are held tightly in jigs, or otherwise, so that they are not free to move, it is recommended that a welding wire consisting of five per cent silicon and 95 per cent aluminum be used. Aluminum and its alloys are hot short at temperatures just below their melting points. At the same time they have a very high solidification and thermal contraction (nearly two and one-half times that of steel). In view of these facts, it is easy to understand how cracks can readily occur adjacent to welds in aluminum, unless some measure is taken to relieve the heavy strain placed upon the joint at the instant of solidification. This relief is provided by the five per cent silicon alloy welding wire.

The silicon welding alloy has a relatively slight solidification contraction, and on account of its having a lower melting point and a wider melting range than the base metal, it remains molten, or at least plastic for a longer time, and fills in the voids caused by the solidification shrinkage of the welded parts in the same way that a gate fills in the shrinkage of a casting. This means that the stresses due to contraction which might otherwise cause incipient cracking in the base metal, shift their effects to the metal supplied in welding. The five per cent silicon welding alloy is noteworthy for its freedom from hot shortness, which probably indicates ductility at temperatures just under the melting point, as well as strength at these temperatures. It will, therefore, stand the strains incidental to welding without the development of cracks. Five per cent silicon alloy has good corrosion resistance and high strength, so that it is safe to use it in welding any of the regular aluminum alloys.

Ordinarily ⅛ inch diameter wire is suitable for welding any thickness of metal up to ⅛ inch, and 5/32 inch diameter wire for the heavier gauges, but this material may be obtained in any gauge to suit the individual preference.

### Preparation of the Edges

In the welding of light gauge aluminum sheet (0.050" and lighter) it is often convenient, though not necessary, to flange the abutting edges. This plan is particularly adaptable to the fabrication of a large number of articles of the same shape. The flange should be about the same height as the thickness of the metal or a little higher. The joint is made by holding the two upstanding edges together and melting these down. No welding wire is necessary for such work as this.

No beveling is necessary for welding moderately light plate or tubing (up to 0.125" thick). However, it is easier to obtain full penetration if the sheets are notched along the edges. The edges of the sheet are cut through the entire thickness, the notches being about as deep as the thickness of the metal and about one-fourth inch apart. In welding the edges are butted close together. By preparing the edges in this manner, the flux works down for the full thickness of the material, and considerable welding rod is saved. There is less chance of "burning through" and the notches also act as little expansion joints, minimizing local distortion.

The edges of heavy material should be beveled as with steel plate to form a 90 degree vee. The vee should not extend through the entire thickness of the material, but a lip of about ⅛ inch should be left. This lip should be notched before welding. This design of joint has all of the advantages of the notched joint and at the same time gives the penetration necessary for heavy material.

Particular care is needed when preparing the broken edges of an aluminum casting for welding, since these are occasionally porous and may contain absorbed oils, which if not removed will cause blow-holes in the weld. A good plan is to heat the edges before beginning to weld, when the absorbed grease will be sweated out and can be wiped off. Perhaps the best cleaning mediums are a wire scratch brush and some gasoline. Not only the edges to be welded, but also the adjacent surfaces above and below should be cleaned with the scratch brush and washed with gasoline.

### Preheating:

Aluminum sheet ⅜ inch thick and thicker should be preheated. This will limit the consumption of hydrogen or acetylene to that required for the actual melting of the seam. Furthermore, preheating will tend to prevent distortion. If the base metal for some distance on either side of the seam is maintained at a temperature not very greatly below the melting point, then, when the torch is

applied to any one point, the additional expansion of this will be small and unlikely to cause distortion. However, local preheating must be applied with care, especially in castings, where the presence of strengthening ribs can possibly lead to fractures during the preheating itself, since these devices tend to prevent the free expansion of the parts. The preheating of the whole object is not always possible, and in such cases local preheating must be resorted to. When total preheating is adopted there is little danger of expansion cracks, provided the heating is done slowly and uniformly, and the object is well protected from drafts during the welding.

A broken aluminum crank case may be taken as a typical example of a cast aluminum job requiring preheating. The crank case is thoroughly cleaned and the broken piece clamped in place. The crank case is then placed in such a position that the crack to be welded is in a horizontal plane. The casting is then preheated. A temporary fire-brick preheating furnace is very satisfactory. The furnace is built with holes for draft in the first course of brick. The remainder of the brick are laid snugly without mortar. A moderate amount of charcoal is placed in the furnace, banking it against the walls. The exact amount of charcoal depends upon the size of the crank case. Enough should be used to bring the casting to the proper temperature in about 30 minutes. It is important that the fire be kept under control and the casting heated slowly and only to a medium temperature. The upper limit should be 850 degrees Fahrenheit. By banking sand against the draft holes in the furnace, the fire can be regulated very closely. In place of charcoal, gas may be used with a proper arrangement of burners. Asbestos paper with holes punched in it for draft should be used to cover the furnace. This type of preheating furnace is very convenient for repair work, but permanent preheating furnaces are recommended for routine work, such as casting reclamation.

As a welder becomes experienced in handling aluminum, he will at times be able to use a low temperature oil or gas torch for preheating. In this case, the preheating is done locally along the crack, just ahead of the welding flame, so that the welding heat will not bring on too sudden a rise in temperature and cause further cracking.

### Supporting the Work

The work should be so supported that the underside of the weld is free, in order that the added thickness of the metal in the weld may form a slight bulge on the undersurface, which can afterwards be dressed down if desired. There is no danger of the metal falling away during the welding unless the weld is excessively wide or the thickness dealt with very large, or melting carried too far.

### Buckling Produced by Welding

In welding flat sheet a certain amount of buckling is practically unavoidable, because of expansion and contraction effects; also certain strains set up in rolling are released by the heat of welding, and the metal is prevented from returning completely to its original cold position, on account of the fact that it is fixed in a somewhat distorted position by the weld. However, most of the buckles are localized in the welded area and they can be straighteend out by hammering after welding. For this reason, it is a wise provision to locate the joints in a position where they can be backed up on either side during the hammering operation. It is best, when possible to avoid making a welded joint where two sheets come together at an angle. This can be accomplished by turning up an angle in one of the sheets and making the weld at least 1½ inches from the corner. The turned up angle will so stiffen one of the sheets that it will not warp, and the slight buckle in the other sheet can be readily removed by a skilled hammer man.

In welding a fitting to a flat panel it is customary to put in the panel an emboss, which is a little larger than the fitting to be welded. This has a tendency to localize the buckling in the area of the emboss and to minimize the buckling in the panel itself.

In welding, the difficulties due to contraction during cooling are increased, since the heating is intensely localized. Therefore, the repair of an aluminum casting, in which the danger of cracking is great due to the hot shortness of the metal, is not to be undertaken without a reasonable amount of knowledge and a large degree of common sense. Many an expensive casting has been ruined by attempts at repair by self-confident but uninformed amateurs, whereas a specialist in the process can rebuild a crank case from a mass of broken parts seemingly ready for the scrap heap.

### Torch Manipulation

In the welding of aluminum one of the main points in which the process differs from that of steel is in the speed of working. The speed is very much greater than with steel, and the movement along the seam becomes more rapid as the metal becomes heated.

The welding rod is held loosely in the fingers, and it is

**Fig. 4. Flux Container Attached to Welding Table.**

kept in a direct line with the weld. The torch flame is directed centrally so that it melts simultaneously both edges of the sheet to be welded and also the end of the welding rod. Both sides of the weld must be heated equally so that the edges will melt at the same instant, otherwise a bulky and uneven weld will result. It is also important when starting that the two edges should commence to melt before any filling material is melted. The welder quickly learns to judge the correct instant to commence running up the seam. Too rapid melting of the metal in a restricted area with the consequent melting of holes in the sheet is prevented by holding the torch at an angle of about 30 degrees to the surface of the sheet. By holding the torch at this angle the outer cone of the flame will envelop the metal well ahead of the point of welding, and so will make welding progress more rapidly. Care must be taken that the weld penetrates the full thickness of the sheet. However, the torch must not be stopped in any one position for a sufficient length of time to melt holes through the sheet; neither should the inner cone of the flame be allowed to come in contact with the metal. The operator should watch the metal carefully for signs of melt- in welding steel sheet of the same thickness. Long seams from the sheet. It is not possible to determine the melting point by the color because aluminum does not change color through the entire heat range used in welding. That is, it does not become red hot, but maintains its characteristic silvery white color even in the fluid state.

### Welding Commercially Pure Aluminum Sheet

The assembly of parts before welding is gone about as in welding steel sheet of the same thickness. Long seams should be back welded progressively from end to end at intervals of three or four inches in order to prevent the edges from slipping by each other. Irregular tack welding produces an unsightly weld and is likely to cause cracks. After tacking, the flame of the torch is played upon both edges of the pieces simultaneously causing them to melt and, the oxide being removed by the flux, the molten edges flow together and coalesce. Only a very small part of the metal is melted at any one time, so that the molten metal

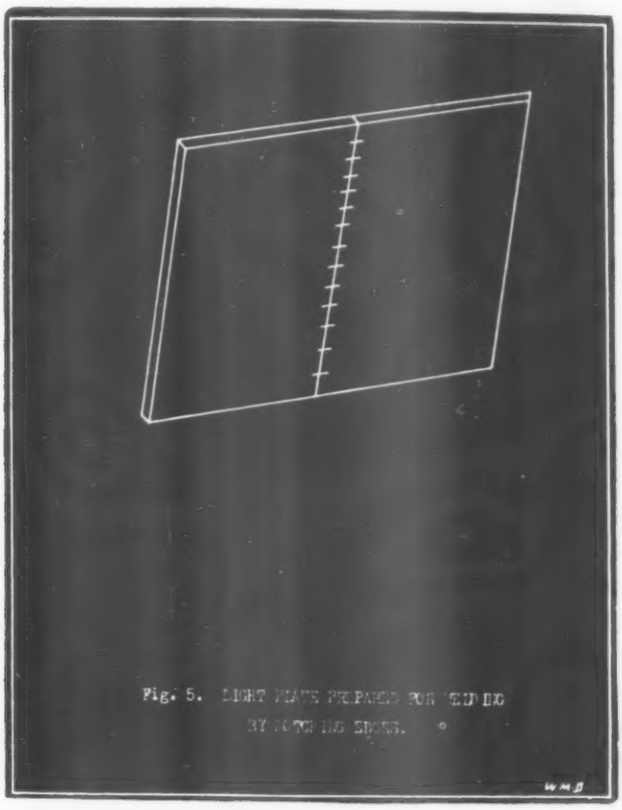


Fig. 5. [illegible]

is prevented by surface tension from dropping away. The welder progresses rapidly along the seam, the edges melting under the torch and solidifying again almost immediately as the torch passes on. The tip of the welding rod should be held in the flame near the metal. Metal from the welding rod must be flowed into the weld by the flame as the heat in the puddle alone is not sufficient to melt the rod. The welder should make sure that the added metal fuses thoroughly with the base metal. The weld should be built up 1/16 inch to ⅛ inch above the surface of the base metal. the weld should be completed as rapidly as is consistent with good workmanship, using a flame of minimum size.

In welding long seams, if pronounced buckling of the metal occurs, it should be straightened out by hammering before proceeding further with the welding.

When the joint is completed every portion of the seam will have been melted and solidified again, hence the metal in the weld is in the cast state.

### Strength of Welds

Some tests were made for the purpose of comparing the strength of welded commercially pure aluminum (2S) and commercially pure aluminum plus 1.25% manganese (3S) pipe with the strength of the original unwelded material. Test samples 18 inches long were prepared from annealed 2S and 3S in ¾ inch, 1 inch and 1¼ inch iron pipe size. The test samples were cut in half and then welded together.

**Summary of Tensile Tests**

| SAMPLE Size | | Condition | % Elongation 2" | 8" | Tensile strength lbs., sq. in. |
|---|---|---|---|---|---|
| ¾" | 2SO | Original | 46.3 | 34.2 | 14,340 |
| *¾" | 2SO | Welded | 46.8 | 32.0 | 13,435 |
| 1 " | 2SO | Original | 54.5 | 36.6 | 12,650 |
| 1 " | 2SO | Welded | 49.8 | 29.7 | 12,975 |
| 1¼" | 2SO | Original | 55.3 | 37.1 | 13,150 |
| 1¼" | 2SO | Welded | 53.5 | 31.8 | 13,175 |
| ¾" | 3SO | Original | 45.8 | 27.3 | 16,680 |
| ¾" | 3SO | Welded | 41.3 | 23.9 | 16,665 |
| 1 " | 3SO | Original | 53.5 | 35.3 | 14,900 |
| 1 " | 3SO | Welded | 49.7 | 30.8 | 15,010 |
| 1¼" | 3SO | Original | 55.3 | 34.8 | 15,515 |
| 1¼" | 3SO | Welded | 53.0 | 31.2 | 15,535 |

*One of three samples failed at weld.

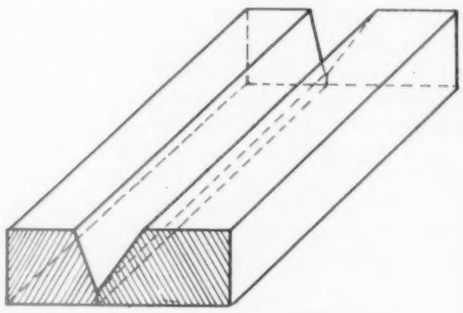


Fig. 6. Heavy Plate Prepared for Welding.

**Summary of Hydrostatic Tests**

| SAMPLE Size | | Condition | Bursting pressure, lb., sq. in. |
|---|---|---|---|
| ¾" | 2SO | Original | 2,850 |
| ¾" | 2SO | Welded | 2,930 |
| 1 " | 2SO | Original | 2,800 |
| 1 " | 2SO | Welded | 2,800 |
| 1¼" | 2SO | Original | 2,200 |
| 1¼" | 2SO | Welded | 2,280 |
| ¾" | 3SO | Original | 3,950 |
| ¾" | 3SO | Welded | 3,950 |
| 1 " | 3SO | Original | 3,200 |
| 1 " | 3SO | Welded | 3,330 |
| 1¼" | 3SO | Original | 2,700 |
| 1¼" | 3SO | Welded | 2,770 |

The summary of the tests results given above shows quite definitely the results obtained.

All welds were made in the plant according to commercial practice. The welds were not dressed, but left as made by the torch, slightly built up. All samples were subjected to hydrostatic and tensile tests. Three welded specimens of each size and kind were tested. In addition, two samples of each size and kind of the original unwelded tubing were tested so as to have a basis of comparison for the welded tubes.

There was practically no difference between the tensile strength of the welded tubes and the original tubes. Moreover, only two out of a total of 18 welded samples failed in the welds. The summary of the test results given in the table shows quite definitely the results obtained.

It should be remembered that the original tubing used in these tests was dead soft, or very nearly so, and that

the above discussion would, of course, not hold for intermediate or hard temper tubing. For many uses of welded aluminum tubing where the material is subjected to elevated temperatures, the tubing becomes annealed in time, and for such cases, the results of these tests are directly applicable. For other uses of intermediate and hard tempers of aluminum tubing where the material is not subjected to heat, it would seem that the strength would, in most cases, be governed by the strength of the tube immediately adjacent to the welded joints where the material becomes annealed from the heat of welding, again making the results of these tests applicable within reasonable limits.

### Welding Castings

When a broken aluminum casting is to be welded, it should first be cleaned carefully, removing every trace of oil, grease and dirt by means of a wire scratch brush and gasoline. Unless the casting has a very heavy cross section, it is not necessary to tool the crack or cut out a vee. If a piece is broken out it should be held in correct position by light iron bars and appropriate clamps, the clamps being so attached as to avoid straining any portion of the casting, especially the thin walls; when near the melting point the metal is very weak and will crumble under slight strains.

The casting, particularly if a large one, should be preheated. Many expert welders are able to do splendid work without preheating, but this ability results from long experience. If the casting to be welded is small, or if the weld is near the edge and in a thin-walled section, the torch flame may be played over the pieces so as to preheat them before starting to weld. The cold aluminum should be heated slowly —a quick heat will crack the metal near the flame. Contrary to welding practice on steel or cast iron, the weld metal must be flowed into the weld by the flame, because the heat in the puddled metal will not melt aluminum. When a few drops are melted off the welding rod, it is worked around and into place with a rubbing motion of the rod. Care must be taken to get the new liquid metal to the bottom of the crack, all the time playing the torch about freely, but always with the tip about two inches from the metal.

When the weld is finished, the casting is annealed by adding four or five handfuls of charcoal and covering the furnace top with asbestos paper. The fire is allowed to burn out slowly and the casting cooled in the furnace.

A charcoal furnace is not necessary when filling holes in castings. Either the whole casting is preheated in a muffle furnace or the area is preheated locally by playing the torch about the hole. The hole should be shaped up so as to remove all pockets and to permit proper manipulation of the torch. In filling blow-holes the cavity should be thoroughly cleaned so that only clean metal is exposed. The preparation of a tooth for filling by a dentist is an analogous operation.

For filling holes and welding castings it is usually preferable to use a weld metal of the same composition as the casting. However, in the case of complicated castings where severe contraction strains are liable to ensue, five per cent silicon alloy welding rod would be more desirable.

A flux should be used when welding aluminum castings just the same as for sheet aluminum; however, there is no objection to puddling also. Puddling alone will merely break up the oxide film and leave it incorporated in the weld metal, thus weakening the weld. The flux will float the oxide particles to the surface and leave a clean sound weld. It is important that the added metal be completely melted and the little pool of molten metal thoroughly worked with the end of the welding rod. By this means the flux and the oxide are worked to the surface of the molten metal and there is very little danger of the finished weld containing particles of flux or other foreign inclusions.

### Finishing Welding

As soon as the weld is completed and the work has had time to cool it should be thoroughly washed to remove all traces of flux. Practically all successful aluminum fluxes are corrosive to the metal, otherwise they would not be serviceable. It is therefore of prime importance that the flux be thoroughly removed within a few hours after welding, especially if the completed job is to be painted or finished in any way. Merely cleaning by means of hot water and a scrubbing brush is not sufficient or thorough enough to remove the flux that may be in crevices or cracks which are

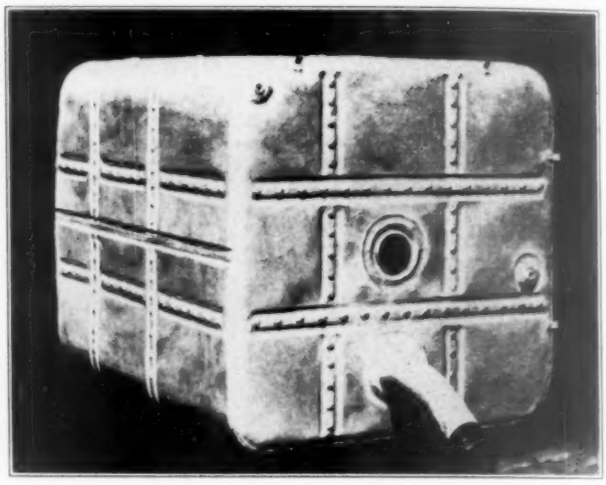


**Fig. 7. Welded Aluminum Gasoline Tank for Aircraft.**

not readily attacked by a brushing operation. A very efficacious scheme for removing the flux is to wash the welds first in hot water to remove the bulk of the flux, then in a hot five per cent solution of nitric or sulphuric acid to remove the last traces; followed by washing in clean hot water to eliminate the acid. Testing with an acidified five per cent silver nitrate solution will determine the efficiency of the operation. If a heavy white precipitate is formed when a drop of the silver nitrate solution is placed on the joint to be tested, the cleansing has been insufficient and the washing should be repeated.

In many instances where appearance is of minor importance, welded aluminum structures are left untouched after being washed, but for some objects it is desirable to remove all traces of welding by grinding off the excess deposited metal. This may be readily accomplished by chipping off the greater portion of the excess metal with a sharp cold chisel inserted in the head of an air hammer. The cutting edge of the chisel should be dipped in light oil frequently to prevent the aluminum chips from sticking to the chisel. The joint is then ground on a rag wheel made up of new clean buffs glued together into a solid wheel. Glue is painted over the grinding surface of the wheel and powdered emery (30 to 120 mesh—usually 80 mesh) embedded in the surface of the glue. The wheel, which is eight inches to ten inches in diameter, should have a speed of about 2,400 R. P. M. American red engine oil or Acopol, an asphalt base engine oil, mixed with equal parts of mutton tallow is used as a lubricant. If an exceedingly smooth finish is desired, a second wheel coated with 120 to 140 mesh emery is used, followed by a buffing operation. The buffing wheel is made up of sewed rag buffs separated from one another by small pads which fit over the shaft in the same manner as the buffs. Tripoli is used on the buffing wheel. Wheels 12 inches in diameter revolving at a speed of 2,600 R. P. M. are recommended. Welds finished in this manner are completely invisible.

When practical it is advisable to hammer the welds subsequent to chipping. Hammering tends to relieve the contraction strains set up during the cooling of the weld

and adjacent metal. Hammering will not be sufficient to completely break down the cast structure in the weld, but it will tend to eliminate the cast structure to some extent and thus produce a more nearly uniform condition throughout the object. Hammering will also tend to obliterate any surface porosity that may be present in the weld.

## NATIONAL METALS EXPOSITION WELL ATTENDED

A report received from the office of the American Society for Steel Treating indicates that there was a total attendance of over 53,000 at the National Metals Congress and Exposition which was held in Cleveland during the week of September 9th. Over 6,000 members and guests of the cooperating societies registered, nearly one-half of the total membership of the societies and considerable more than twice as many as have registered in previous years. There was an attendance estimated at over 8,000 at the various technical sessions an increase of several hundred per cent over recent years. This fact, perhaps better than any other indicates the character of the visitors who are coming in increasing numbers annually to the greatest event in the metal world.

For several months prior to the Cleveland event, The Welding Engineer supplied its readers with advance information concerning the programs and urged the attendance of all those who were interested in welding. Undoubtedly a good many of our readers responded to this recommendation and it is certain that they felt well repaid for the time spent. Scores of them stopped at the Welding Engineer booth at the Cleveland show and were unanimous in their opinion that they did not want to miss an exposition of such importance to them. Those who missed the event entirely should start now making their plans to be present when it is held at the Stevens Hotel in Chicago next September.

There is every indication that the Welding section of the exposition is improving from year to year. Manufacturers are paying careful attention to the demands of the public and arrange exhibits which are more and more educational. A visitor at Cleveland could not fail to be impressed by the fact that during exposition hours the areas around the welding exhibits were crowded and that the crowds were not moving but standing still. In other words, they were staying right there to see the processes demonstrated and to collect the information which was available for them. There were no tricky or circus type stunts. They were all of a practical, educational character, which is further proof that the show was attracting the kind of people who are more interested in improving welding processes than they are in stunts.

Notable success also attended the program of the American Welding Society. There was a splendid collection of technical papers on subjects of current interest presented at the technical sessions and the lively discussions indicated the interest which the authors of the papers had created. These programs are supplying industrial engineers with a great volume of valuable fundamental information, on all of the welding processes, and those tending to establish the use of these processes on a sounder and more satisfactory basis in all forms of industry from year to year. A meeting of the Membership Committee of the Society brought out the information that although there are yet many thousands of possible members to be added to the list, the membership is growing, and that the increase in membership is largely drawn from men of the executive type. The committee made definite plans for an energetic membership campaign for the next twelve months, which will undoubtedly result in a considerable increase. Another important activity was the appointment of a new committee to recommend procedures for qualifying welding operators for definite classes of work. It is thought that the work of this committee will be one of the most significant forward steps which the society has ever undertaken as it will make possible a systematic control over what has been referred to as the human element. There is no doubt but what this movement will be as beneficial to the welders of this country as it is to their employers, as it will give them a definite schedule by which to measure their ability and thus serve an indication to them of possibilities of improving their skill and consequently their earning capacity.

## TULSA SECTION OF A. W. S. FORMED AT OIL SHOW

The welding industry was auspiciously featured at the International Petroleum Exposition at Tulsa, Okla., on October 11th with a series of events programmed to show the important part played by welding in oil and gas operations. The American Welding Society held a session at the Exposition auditorium in the morning followed by a welders' contest in the afternoon and a banquet at the Mayo Hotel in the evening at which time a Tulsa section of the American Welding Society was formally organized. Inclement weather cut down the attendance at the various events but did not dim the interest and enthusiasm shown.

At the morning session of the Society presided over by H. C. Price, Welding Engineering Co., Bartlesville, Okla., addresses were delivered by O. A. Tilton, arc welding division, General Electric Co., on "Structural Steel and Pipe Line Welding" and by S. C. Clark, Linde Air Products Co., on "Procedure Control and Its Part in Development of Oxy-acetylene Process in Modern Industry." William Spraragen, secretary of the research department of the Society, also spoke on "The American Welding Society and Its Relation to the Welding Industry." Despite the inclement weather about 75 attended the meeting.

The welders' contest, though abbreviated by rain, was carried out at the Exposition grounds and attracted much attention. There were 15 individuals representing both major oil concerns and commercial shops and the program called for welding of six-inch pipe with awards based on neatness and width and penetration of welds. E. H. DeWitt, Oklahoma Natural Gas Corp., Tulsa, won first prize and received a silver loving cup donated by the Exposition management. Second prize went to R. Cox, of the same company, and third prize to E. F. Loerwald, Smith Engineering Co., Cushing, Okla. The former received angle and plane projectors and the latter, a pair of goggles, donated by exhibitors. R. L. Banister, Gypsy Oil Co., Tulsa, Okla., supervised the staging of the contest.

Tulsa section of the American Welding Society was formally organized at the banquet held in the main dining room of the Mayo Hotel. N. E. Wagner, superintendent of welding, Prairie Pipe Line Co., Tulsa, was elected chairman; H. C. Price, Welding Engineering Co., Bartlesville, Okla., vice-chairman, and J. C. Haymaker, Prairie Pipe Line Co., secretary-treasurer. An executive committee of 12 members was tentatively elected and plans made for affiliation with the American Welding Society. Impromptu addresses were made by A. E. Gaynor, senior vice-president, American Welding Society, and by William Spraragen, secretary, the former dealing with procedure control and the latter with general aims and purposes of the Society. Short talks were also made by the newly elected officers.

Plans are being formulated by Chairman Wagner and other officials to make the Tulsa section of the Society an important cog in the work and activities of the national association and to raise the standards of welding practice in the Southwest to a high plane of endeavor. Their efforts will especially apply to oil field welding, already a dominant figure in the welding industry.

# Spot Welding Non-Ferrous Metals

## Much Finer Calibration of Current Densities and Pressure Must Be Used Than When Welding Ordinary Mild Steel

By M. L. Eckman*

RESISTANCE welding of the common non-ferrous metals, such as phosphor and aluminum bronze together with the aluminum alloys such as duralumin and other special alloyed mixtures of aluminum have always been considered hard to weld and perhaps they have been in the past.

However, a little discussion of this subject should enable almost any one to weld these materials with satisfactory results.

There have been many reasons advanced just why these materials are hard to weld by resistance process, either spot welding or butt welding, but the real reason is that they are such good conductors of electricity that very little heat is generated by the passage of a large volume of electrical energy.

Steel heats readily from a moderate amount of electric current; copper and aluminum do not. Of course, as we all know, as soon as material of any kind starts to heat it immediately creates more resistance and this works advantageously in resistance welding. Therefore, anything that will increase the resistance between these pieces to be welded will aid us in welding.

In my own experience I have seen many ways tried of increasing the resistance between aluminum or copper or alloys in order to obtain a welding result. Sometimes corrosive acid reactions were attempted. I have seen one and a half thousands shim steel placed between the two pieces to be welded, which started them to heat; and the increased resistance followed this up to a point where a successful weld was accomplished. I have seen two pieces of ordinary one-eighth cold rolled steel placed on either side of the points of a spot welder welding sheet aluminum or sheet copper and good results achieved from this.

However, I believe that excellent results can be obtained from ordinary copper spot welding points if just a few factors will be born in mind. As stated before, anything that increases resistance between the welding electrodes is advantageous.

What will increase resistance between spot welder points more than lack of pressure on the pieces to be welded?

Steel will weld at almost any reasonable pressure because there is so much resistance of the steel itself to the passage of electric current, but in copper or aluminum alloys this is not the case; therefore, an easing up of the *pressure until just before the point where arcing occurs*, which will immediately burn holes through aluminum or copper (or any other material) *will increase resistance*. This is a very delicate adjustment and must be handled carefully or the points and the parts themselves will be ruined beyond repair. Whereas in welding steel together (such as sheet steel for automobile body work) a wide variety of pressure and current densities may be used and still good results obtained. In the welding of copper or aluminum alloys much finer calibration of current densities and pressure must be used or results will be disastrous.

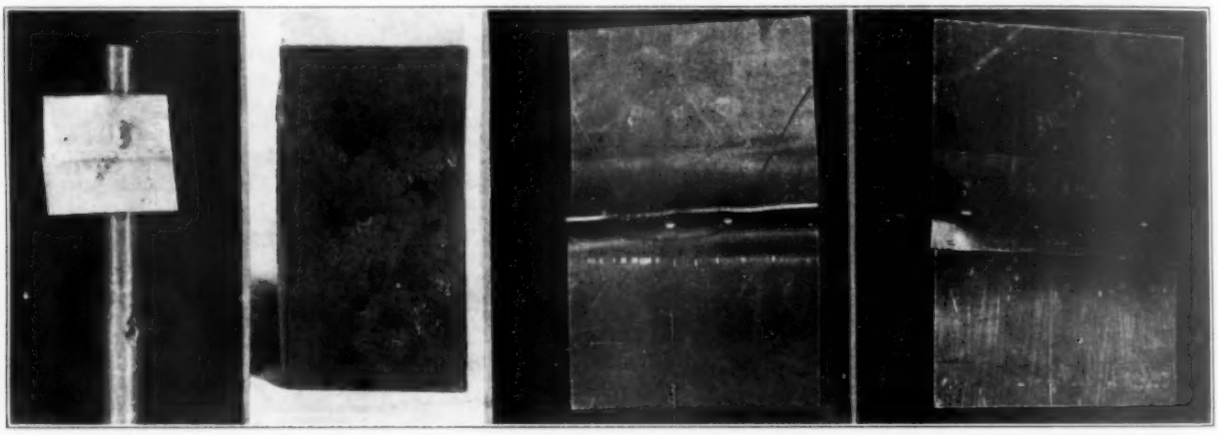


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

Let us go through the procedure of welding two pieces of sheet aluminum, say of 16 or 14 gauge. I would suggest that the lower spot welder point be flat, somewhere around an inch to an inch and an eighth in diameter. I would suggest that the upper point be a spherical point of say possibly one-quarter inch radius. The pieces to be welded are placed between these points and the pressure on the points is adjusted very carefully to just a trifle more than will stop arcing which, of course, will burn holes entirely through the material to be welded if same should occur.

As stated before, the pressure is adjusted very carefully just to eliminate arcing. A considerably higher density of current is used than in ordinary spot welding of steel. This is because these good conductors necessitate more current to accomplish the same results. The current is turned on and many will remember the older days when we were welding aluminum with a torch and we were informed and instructed by our instructors that we must break the oxide scale by puddling if we ever wanted to actually make fusion between our aluminum rod which we were adding or the pieces which we were attempting to weld together. The same thing is necessary in welding these two pieces by resistance. When the heat generates there is an oxide scale immediately formed over the pieces or over the surfaces to be welded together. This is broken in spot welding

*General manager, Taylor-Winfield Corp, Warren, Ohio.

by a following up, pushing, or squeezing action between the electrodes. This can only be accomplished by a machine properly designed to take care of this squeezing action between the points whose pressure was very little at the start of the heat. This is a vital point and must be remembered by all those desiring to weld non-ferrous metals such as those being considered.

This brings us back to the old adage which all good welders have had drummed into our ears for years, that good welding is just heat plus pressure properly applied. However, where the range of heat and pressure could be quite broad in the welding of steel and iron it is of rather fine and close adjustment on the welding of aluminum and aluminum alloys as well as copper and copper alloys. This is a vital point and must be remembered if good welding is to result.

In the welding of copper and copper alloys the same thing holds true exactly. A light pressure between the points and then as the heat starts to generate a quick squeezing of the pieces between the points with the correct current density will make a very successful weld on copper, phosphorous bronze, aluminum bronze or other copper alloy.

If uniform welds are to result, the machines must be so built that they will operate entirely automatically and that each cycle is performed with exactly the same time elements and the same current densities as its mate or the original set up. This can only be achieved by automatically operated spot welders. Our own Taylor-Winfield machines are examples of the results of this careful designing and building.

In the butt welding of these materials the same thing holds good. Very light pressures must be applied on the pieces to be welded, then this must be followed up by *direct* proportioned pressure to the pieces in process of welding.

Aluminum sheets and bars as well as copper, phosphor bronze, and so forth are welded successfully every day in this manner by following up with the correct pressure when the current has started the pieces to heat increasing their resistance to the point where welding is obtainable.

The illustrations demonstrate these facts. For instance, Figure 1 is a Duralumin tube with a Duralumin sheet spot welded to the tube. On the lower half of the tube you can see where a similar sheet was spot welded and torn away, leaving a slug fast to the tube, proving that it was strong enough to tear out metal.

Fig. 2 shows a couple of pieces of sheet Duralumin spot welded together and partially torn apart to show the strength of the weld. Note how the slugs pull out of one or the other half leaving holes in opposite members.

Figs. 3 and 4 are two pieces of 16 gauge aluminum spot welded together. Fig. 3 is partially torn apart showing the strength of the weld and showing the distortion that this will stand before the metal starts to give.

Fig. 5 is a piece of copper that has been spot welded together and one spot pulled apart to show that it has made a real union.

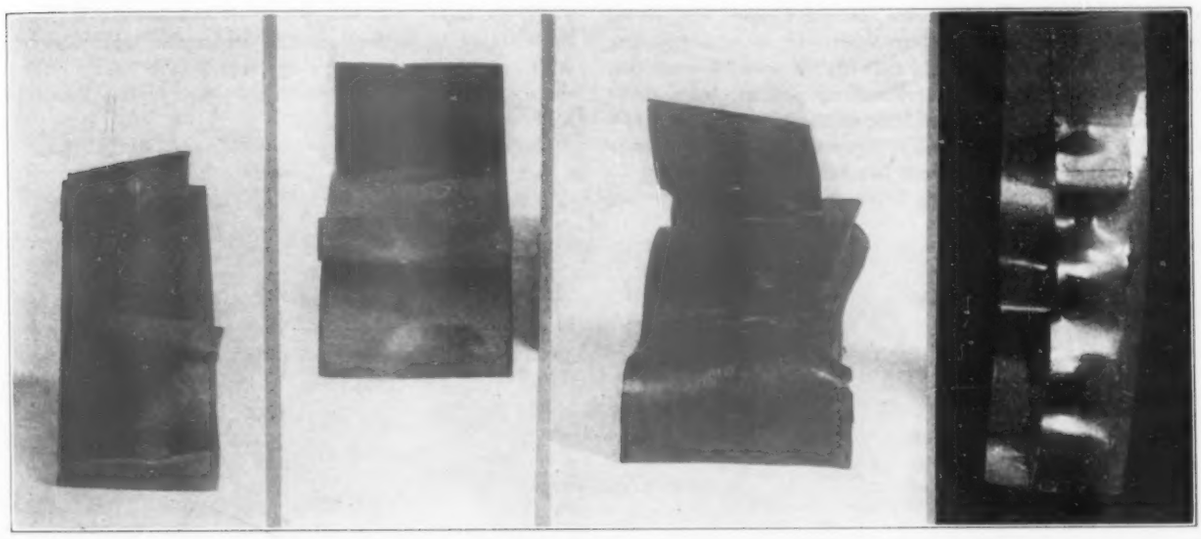


Fig. 5. Fig. 6. Fig. 7. Fig. 8.

Fig. 6 is a phosphor bronze that has been spot welded together and one or two spots torn to show their strength.

Fig. 7 is a piece of ordinary sheet brass that has been spot welded together and then pulled apart.

Fig. 8 is just a thin piece of aluminum welded to show its possibilities.

These are not isolated examples but are the usual thing in welding practice in our experimental shop and can be duplicated at any time.

I believe that a broader understanding and greater knowledge of the principles back of welding of these good conductors of electric current will enable most users of resistance welding to duplicate these results with very little trouble, remembering, of course, that there is more current needed to weld these good conductors than is needed to weld ordinary steel and iron and also that a very light pressure at the beginning of the heat with a follow-up or quick squeezing of pushing together of the pieces to be welded at the proper time are real factors in good resistance welding, whether it be spot welding or butt welding process.

## MISO STEEL MADE INTO A GREAT VARIETY OF WELDED PRODUCTS

At the recent National Metals Exposition held in Cleveland, The Michigan Steel Casting Company had an extensive collection of welded products made of their alloy, Misco. They formed a variety of containers of numerous shapes and sizes, most of which are used in holding products which have to be heat treated in high temperature furnaces. This metal is readily welded by either the gas or arc welding processes, using the Misco wire for filler. The welding of the cast metal takes more care but is successfully accomplished as a rule.

# Welded Power Apparatus

## Some Fundamental Considerations Involved in the Substitution of Fabricated Steel Parts for Castings

By H. V. Putman*, and C. C. Brinton**

THE substitution of punched, pressed and rolled steel for castings, which has been increasing in importance for many years in the electrical industry, has been supplemented by the further substitution of fabricated (usually arc-welded) structural steel instead of castings for the largest and most complicated frames, bedplates, etc., until castings bid fair to be a rarity in the no distant future. This is not a new idea; rolled steel motor frames have been common for sixteen years or more, ante-dating even the use of electric arc welding with the metallic electrode. But the general application of fabricated steel in place of castings in the construction of the larger rotating machinery is relatively new, and the change is not even yet completed. This change is the result of a number of different factors.

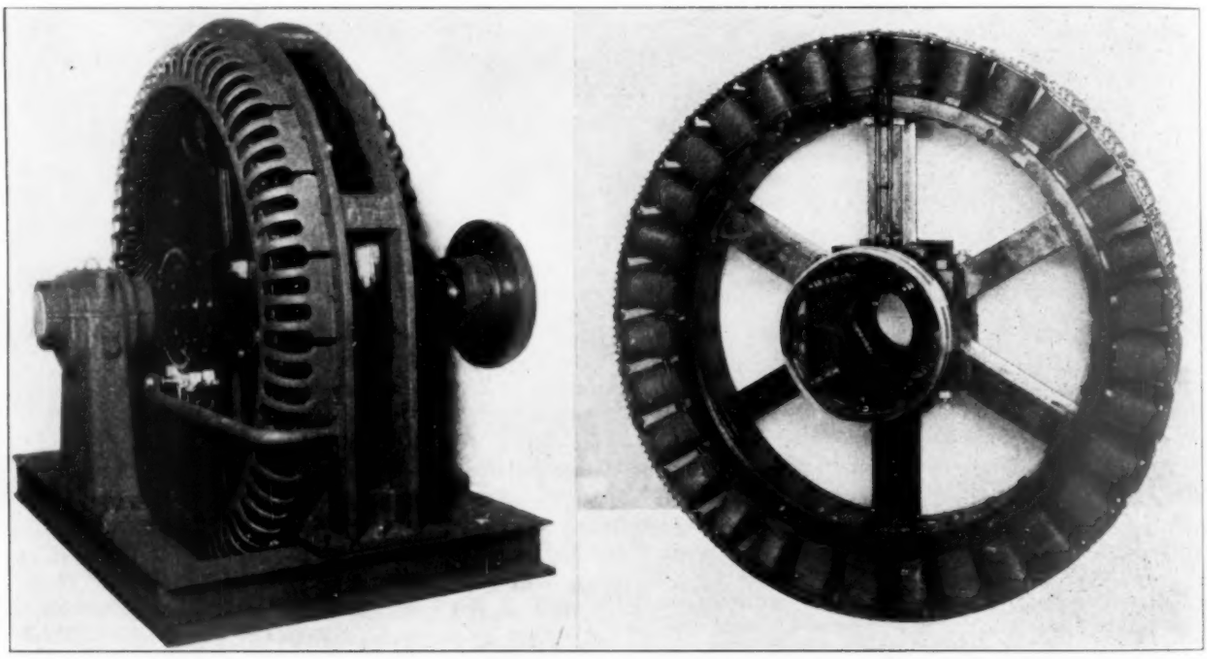
The big advantage of this type of construction lies in the fact that complicated parts can be made up in much less time than is required for the making of a pattern and casting; using steel shapes which are the standard product of steel mills. To realize on the possibilities of this method of manufacture, it is necessary to carry a large and varied stock of standard shapes, bars, slabs, plates, etc. The selection of the kinds and amounts of such stocks requires a careful study of the activity of the various types of structures that are to be fabricated, as well as the equipment and manufacturing methods to be used. By careful administration of the application of the stock, scrap ratios can be kept within reasonable limits, but it is essential that a careful layout be made of the stock size in each application.

The machining of a casting is a longer and more costly operation than that of rolled steel parts, because of the excess stock which must be added to a casting to insure that the machined parts will clean up. In addition, the chilled scale, sand and hard spots that are encountered on the surface of a casting slow up the speeds and reduce the feeds to a great extent, and also cause considerable tool breakages. The inevitable losses that occur from defects, which are not found in a great many cases until the machining is practically finished, form another frequent source of delay and extra cost. The use of fabricated steel parts, therefore, makes it possible to reduce the machining time considerably, as well as to eliminate certain machining operations which are necessary with castings on account of the uneven surface and inability of the foundry to maintain uniform dimensions.

The manufacture of special parts from castings always requires a pattern and possibly several core boxes with the problem of storing these in good condition for replacement. Parts made of structural steel, however, require only the making of the drawings before actual fabrication can begin.

When designing cast parts, in order that the foundry may produce a casting free from shrinkage, strains and flaws, it is necessary in many cases to add extra stock where such additional metal is not required for strength. This handicap is not met with in using structural steel, where there is a great variety of standard shapes of various weights, so that the designer is seldom forced to choose a part that is larger or heavier than is necessary to do the work required.

Because of the easier machining, and the smaller amount required, it is possible to manufacture fabricated structures with fewer machine tools. It is also possible to manufacture complete under one roof; even in the same aisle.



**A Typical 600 HP, 100 Percent Power-Factor, Three-Phase, 60 Cycle Synchronous Motor**

**A Rotor for a 300 HP, 225 R.P.M. Three Phase, 60 Cycle Synchronous Motor**

**The only castings used in these motors are those of the bearings and pedestals. Segments cut by automatic gas-cutting machines from a steel plate, bent to shape and butt welded together form the stator. The end bells are made from steel stampings. The new method of holding the laminations can be seen here. No cast iron is used in the rotor. The arms are made by arc welding together H-beams, welded to the hub which is cut from heavy steel plates.**

### EQUIPMENT

For simple structures consisting of straight parts, the only special equipment needed consists of cutting and arc welding tools, with suitable welding fixture for holding the parts together for tack welding, preparatory to welding them together perma-

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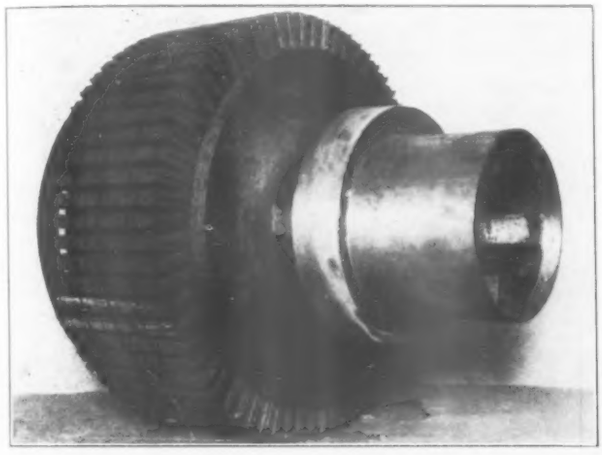
**Manufacturing Engineer, Westinghouse Electric & Mfg. Co.

nently. Such fixtures must be carefully designed in order to minimize the amount of machine finishing necessary, and to leave enough openings to permit welding the parts together easily.

With larger and more complicated structures, requiring the bending and forming of plates, bars, slabs and structural shapes, special equipment is necessary. The layout of such a plant may be roughly divided as follows:

1. A plate shop consisting of gas-cutting equipment, shears, bending rolls for producing cylinders or parts of cylinders, machines for bending plates at angles, and flanging presses if needed. Gas-cutting equipment is used to cut from templates to any desired irregular shape, and for straight line cutting from plates up to eight inches in thickness. Plate benders and flangers are used where it is more economical to bend or flange plate than to weld two or more pieces together.

2. A beam shop for the fabrication of bed-plates from H-beams, upper and lower brackets of vertical machines from I-beams and plates. The equipment consists of gas-cutting and arc-welding equipment, with a suitable area of floor plate for holding the parts level while welding.



**A Slow-Speed Direct-Current Armature**
Made entirely of steel bars and plate welded together. The integral construction of the armature and commutator spiders are clearly shown.

3. A shop for the bending of slabs up to ten inches thick for direct-current frame rings and alternator spider rims; and the edge bending of large sections for alternator frame rings. This shop requires heavy bending rolls and possibly a crimping press, with a furnace for heating the heavy sections, as well as approach tables or similar equipment for the handling of the hot slabs.

For the assembling of the parts it is essential that good floor plates be available for setting up the work, as well as suitable fixtures for holding them true while welding. The greater part of the final welding is done on automatic welding machines, in order to secure uniform welding as well as to minimize the costs.

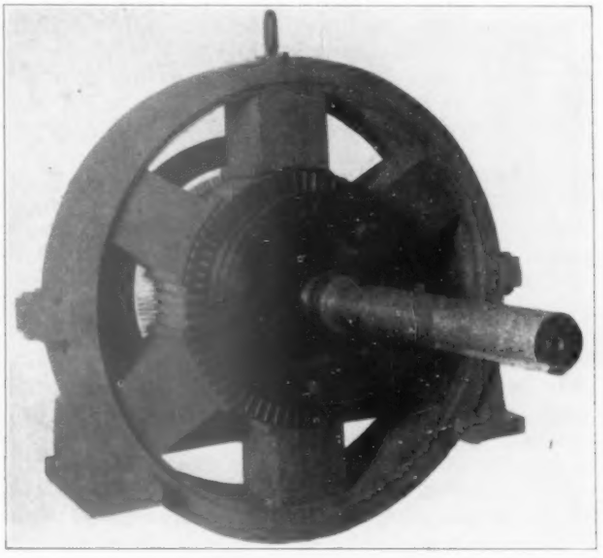
TOLERANCES

One of the difficulties met with in the fabrication of structural steel parts lies in the variations in the dimensions, and the distortions which occur during the manufacture of plates and structural shapes. Variations in the thickness of plates are not usually a disadvantage, but lack of flatness within limits is a distinct handicap in endeavoring to minimize the amount of machine finishing, as well as to eliminate some of the usual machining operations necessary with castings.

When using standard structural shapes and slabs, the usual tolerances for dimensions and straightness are not close enough to realize all of the economics possible with this form of construction. These shapes are no doubt within reasonable limits for the purpose for which they were originally designed; but where machine finishings are required without removing too much material, the present tolerances are not as close as is desirable. To secure the greatest application of such parts for machinery it is necessary that they be produced commercially with smaller tolerances in the regard to height, camber and straightness.

DESIGN

One of the big problems in the design of structural steel parts has been to have the designer think clearly and with an open and unprejudiced mind about the fundamental design problems in the application of fabricated steel. Such a fundamental study of previous designs using cast iron showed that some of the main features of the design were the result of the limitations of foundry practice, or of machine tool equipment, rather than of the fundamental requirements of the electrical machine. It is desirable therefore to forget all that was previously known about cast iron design—even the appearance—and to start with an open mind to determine exactly the requirements of the machine or structure; and then to study the structural materials to see how they can best be employed to meet these requirements. The result of such a fundamental study is shown in the accompanying illustrations; the new designs are radically different from cast structures and often much simpler in construction. Any savings are found to be directly proportional, not to the decrease in weight, but to the simplicity of the design, and to be inversely proportional to the amount of welding. They are dependent also on the general stability of the design to structural materials.



**Welded Armature Resting in Its Stator**
Which is also made from structural parts. The frame consists of two steel slabs bent semicircular and with lugs welded at the split. Steel plates welded to the frame serve as feet.

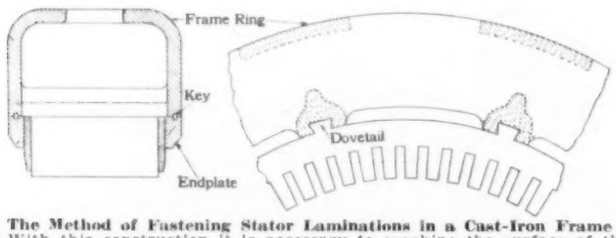
This can be explained in more detail by using a specific example. The first line of machines to be completely fabricated was that of low-speed synchronous motors. The frame construction chosen is an excellent example of what happens when one puts aside all ideas of cast construction and sets out with an open mind to design a fabricated frame structure to meet certain definite requirements. Some details of the two types of construction are shown in the accompanying sketches.

The cast frame is of the box-type construction, having the laminated core held in place by dovetails and clamped between two end plates which are keyed in position after the core is stacked. The cast frame is machined at the bore and on the sides. In addition another set-up is required on a different machine to cut the dovetails. Besides this, the two end plates, which are slender castings and difficult to make, are machined on all sides.

The fabricated frame consists simply of two frame rings gas-cut from a solid plate with the core held in place between the rings by frame bolts, which also serve as a means of properly tightening the core. Between the frame rings at the back are welded ribs of channel iron which give rigidity to the structure and serve as a means of lifting. Note the simplicity of the construction. There is no boring mill or milling machine work any-

where on the frame. Nothing but a gas torch, arc welder and drill press are used in making the frames. Even the bottoms of the frame feet are not machined and yet the structure fulfills all the requirements. It would have been easy to fabricate a box-type frame, use fabricated end plates, machine the frame and assemble it in the usual way, making it look like the cast frame. This is the result where the designer thinks in terms of cast iron and orders fabricated steel in his bill of material. It is not the kind of design produced when the designer says "These are the requirements of my structure. Here are the fabricated materials to be used. How can they be utilized in the simplest manner to fulfill these requirements?" With this attitude of mind engineers produce designs which capitalize to the fullest extent the possibilities of fabricated steel.

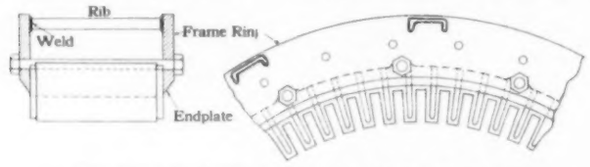
The general suitability of design to structural materials is an important point which is often overlooked. Structural materials are partially finished materials, and to be suitable for their use a design should be so made as to use the rolled surfaces of the plates and bars as finished surfaces in the completed structure. This means that much of the machine work required on cast




**The Method of Fastening Stator Laminations in a Cast-Iron Frame**
With this construction it is necessary to machine the surface of the frame ribs and cut in them the dovetail slot for the laminations.

structures can be eliminated when the fabricated construction is used—provided the design is properly made.

Another point of interest in this frame construction is the fact that it is entirely open in the back. This is, to say the least, a radical departure from the cast frame, but why not depart? The plate on the back is unnecessary for strength except in very wide machines, and by leaving it open the ventilation is much improved. Something is gained and nothing lost. Of course, if the object were to make a frame look like a cast frame, a plate would be put on the back, but it was agreed to approach this design problem with an open mind, forgetting cast construction altogether, with a view to producing the simplest frame construction. Put-




**The New Method of Fastening Stator Laminations**
The laminations do not have the customary dovetails but have holes stamped in their edges. Thus more laminations can be punched from a given sheet. The laminations are slipped over round rods welded on the stator bars, pressure being applied by nuts on the outside of the end plates. No machining is necessary.

ting the plate on the back makes a poorer design and one which is more expensive.

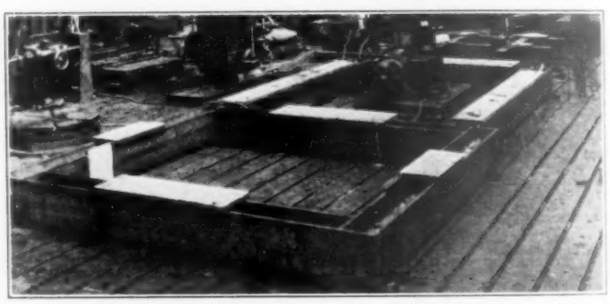
It was with the same object—of obtaining a design especially suited to fabricated steel—that it was decided to stack the punchings on bolts. The bolt is obviously more suitable to the fabricated construction. To cut dovetails in cast iron is an expensive operation, but to cut them in ribs of rolled steel is still more difficult and expensive. Yet there was a good deal of apprehension about the use of bolts. The location of the holes drilled in the frame rings is depended on entirely to make the core round, and doubt was expressed as to how nearly round it would be. It was also felt that trouble might be experienced in getting the core to stack up straight and square. But the bolt was felt to be the only construction suited to fabricated steel, and hence it was tried out thoroughly in the narrow core machines, possibly up to 10 inches wide. Today, after two and one-half years experience, the largest turbogenerator in the world is built in a fabricated frame with the core stacked on bolts. It has a core of 220 inches.

The point to be gained from this frame illustration is that if designs in structural steel are to be successful, the design problems must be approached with open and unprejudiced minds, forgetting both the general construction and appearance of cast structures. By doing this, the designs will be suitable to structural materials. They will be simpler than cast designs and will have less machining, because they will make use of the fact that structural materials are already partially finished.

Now it may be that this same attitude of open-mindedness on the part of the design engineer may cause considerable distress to the sales department. While actually it is economically sound, practically it may produce structures which are so radically different in appearance from the cast structures he is accustomed to, that the salesman throws up his hands and wants to know how in the world he is expected to sell machines so radical in appearance.

Experience has shown the answer to this problem. When fabricated bedplates were first made of H-beams, they were considered ugly. But that did not last long. The fabricated bedplates were better than the cast ones. And today the same people who once thought they looked so terrible will tell you they are actually better-looking than the cast bedplates.

We didn't change the looks, but we did find that an old principle applies—that what looks good is simply a matter of what we are used to looking at. If we are accustomed to looking at cast structures, they look best. If we are in the habit of looking at fabricated structures, they look best. What is radical today is commonplace tomorrow.



**A Bedplate for a Steel Mill Motor-Generator Set**
H-beams are laid with the flanges vertical. The pads welded to the flanges support the pedestals and motor frames.

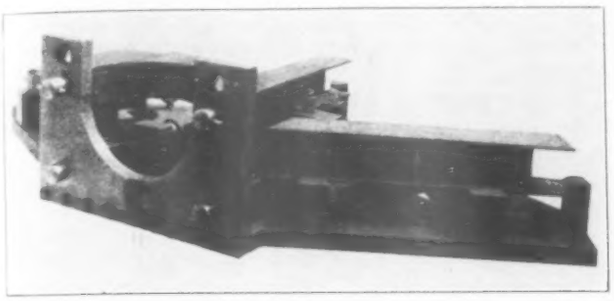
Now, if this principle is true—that apearance is not an intrinsic quality of the design, but simply a matter of what one is used to—there is another principle which follows from it as a corollary. It is this. We cannot justify from an economic standpoint, the expenditure of a single cent to make a design "good-looking." We must not do machine-work unless it is necessary. We must not add plates or put in holes just to make a structure look like a cast structure. It is not sound engineering. In the long run, that machine will both look best, and sell best, which is most closely and simply adapted to the purpose for which it was designed.

### THE LIMITATIONS OF FABRICATED STEEL CONSTRUCTION

There seem to be two classes of structures for which a fabricated steel construction cannot be justified. First, small structures of high activity. Examples are the frames and brackets of small diameter machines, like induction motors and general-purpose synchronous motors. Here metal patterns are used with automatic moulding, and the machining operations are done by automatic machines of the highest development. Castings are cheap, machining is cheap, and the fabricated steel construction invariably proves more expensive.

The second example is the case of structures of such peculiar shapes that they are not readily made out of the commercial shapes of steel, such as bars, beams and plates. Pedestal bearings are a good example. Many attempts have been made to fabricate

bearing pedestals, but so far it cannot be done at a cost comparable with cast pedestals. Some pedestals have been made for anti-friction bearings and some for sleeve bearings, but there are so many little pieces, and so much welding is required, and there seems to be almost no saving in the machine-work due to the use of the fabricated steel, so that the cost is always excessive. But here again, a more courageous abandonment of preconceived ideas of what pedestals should look like may change this situation.

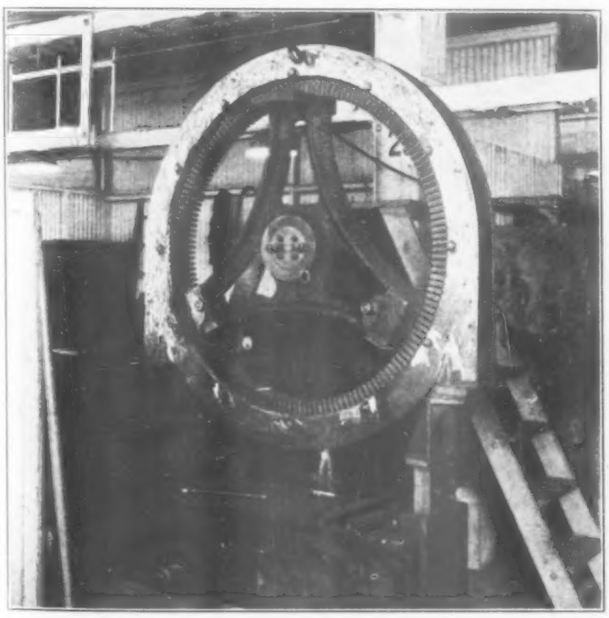


**A Welding Fixture for Use in Fabricating Rotors**
The H-beams for the arms and the steel plate hubs are held in place, properly spaced and true to each other during the welding process. It is unnecessary to make any heavy machine cuts after welding.

CONCLUSION

In any fabricated steel program, it is usually difficult to show any great saving over a good cast design when made with good foundry equipment and machined on modern machine tools. It is felt, however, that even at the same cost, the use of fabricated steel is justified for the following reasons:

1. The possibilities of future cost reduction are greater, because the fabrication of steel is a comparatively new art, while the cost reduction possibilities of the cast construction may have been largely exploited.



**A Stator Welding Fixture**
Used to hold the frames true to the bore while the feet are being welded, thus insuring that they are square and true to the center of the frame. It is therefore unnecessary to do any machining on the feet. All preliminary drilling and machining is done previous to the welding operation.

2. The fabricated steel design is flexible. A large number of different structures can be made from a limited number of parts by welding them together in different combinations—also, minor changes are easily made. Greater strength can be obtained by adding additional members to a design made up originally for lighter service. These are some of the things which make the design flexible.

3. The elimination of patterns is a clear gain. This is of greatest value in large, special machines where only a single unit is made. Also, most large bedplates are special. There are very few exact duplicates, and with castings, patterns are continually being changed.

4. Shorter deliveries are possible with the steel construction. With the foundry and the pattern problem out of the picture, a shorter and more direct manufacturing sequence is possible. In fact, the whole process can be done in the same shop. Greater concentration of responsibility in the manufacturing organization can be had and this means greater efficiency and quicker production.

5. Fabricated steel structures are often better structures than were the cast. There are many sales arguments to be advanced in their favor and they are being demanded more and more by the public.

These are some of the principal reasons why the fabricated steel construction is being adopted for large power apparatus—including engine and coupled type synchronous motors and generators; vertical water wheel generators; high-speed and low-speed direct-current generators and converters; all bedplates; and, finally, turbogenerator frames and bases.

## SAFE WELDING PRACTICE DISCUSSED BY NATIONAL SAFETY COUNCIL

A number of the practical problems of accident prevention in the welding industry were considered at the recent sessions of the Annual Safety Congress in Chicago, which was attended by about 7,000 delegates from all parts of the United States and from a number of foreign countries. It was the largest Safety Congress ever held, and the exhibit of practical accident prevention machinery and equipment was much the largest ever assembled.

A safety report, somewhat related, was delivered at the Tuesday morning session of the same section by F. G. Bennett, safety director of the Buckeye Steel Castings Co., of Columbus, Ohio, as the report of the Foundry Research Committee of the Metals Section of the National Safety Council.

Before one of the sessions of the American Society of Safety Engineers, R. F. Thalner, who is safety director of the Buick Motor Company, of Flint, Mich., and chairman of the ASSE-Engineering Research committee on the Effects of Annealing on Chains, made a progress report. This committee represented eighteen different companies and organizations and government departments. Their printed report contained a diagram of a machine for repeated-load tests on chain, installed in the Materials Laboratory at the Carnegie Institute of Technology and designed by Prof. H. A. Thomas.

The tentative conclusions of their work during the past year was stated to have substantiated their general conclusions presented at the previous annual session. The report stated that "the result of the tension tests seem to indicate (1) that the larger the fatigue load, within the limits of these tests, the greater the tensile strength of the samples selected after fatigue failures had occurred; and (2) that fatigue and annealing both lower the tensile strength of the chain."

"Progress in Gas Welding Safety" was the title of a paper prepared by H. S. Smith, consulting engineer of the Union Carbide & Carbon Corporation, New York, and read by J. I. Banash, consulting Engineer of the International Acetylene Association, at the Wednesday morning session of the Metals Session. This paper showed how welding has been developed as a safe method of construction in many important fields of metal fabrication through the application of procedure control. The reading of this paper was followed by an hour or more of lively discussion, participated in by W. A. Slack, president of the Torchweld Equipment Company, Chicago, and J. J. Crowe, engineer of the research development section of Air Reduction Sales Company, New York City.

# Welding Copper and Its Alloys*

## Basic Principles of Successful Welding—Welding Tests on Copper of Various Grades by Different Welding Processes

By Ira T. Hook†

**In Two Parts—Part I**

### FOREWORD

IN reviewing the large mass of literature devoted to welding which has been accumulating rapidly since 1917, we find that comparatively little is said about the welding of copper and copper alloys. This in spite of the fact that there is an ever increasing demand for this element and its alloys[1] both on account of its utility, its economy over long periods and its artistic beauty.

Aside from the question of first cost, the reason for this is probably because, in the first place, copper with its extraordinarily high heat conductivity offers inherent difficulties to the welder and he is prone to seek other metals which are easier to manipulate. Secondly, nearly all the copper that is sold as such is electrolytic or Lake copper carrying small percentages of cuprous oxide which cuts down the welded strength to 50 per cent of that of the dead soft material. Finally, pure copper has but a modest strength and it is only within the past three or four years that high copper alloys with excellent welding characteristics combined with equally good strength have been made available.

It is the purpose of this paper, therefore, to review briefly the published facts concerning the welding of copper and to dwell at greater length on the newer alloys carrying 96 per cent or more of copper, which have recently come into use. Brief mention will be made of other copper alloys except the brasses and bronzes which have been dealt with at some length in a previous paper.[2]

### Copper

Elementary copper is a relatively soft, tough, ductile metal having a distinctive red color and a tensile strength in the annealed condition not far from 30,000 lb. per square inch. Its high electrical conductivity makes it indispensable to the power industry and its resistance to atmospheric corrosion makes it of immense practical value in the form of sheet metal, wire and tubes, while the keen aesthetic sense of the ancient Greek found great satisfaction in the beauty of the metal, when polished, or when covered with varied shades of its pale green patina. While copper is easily recognized and, as sold commercially, one of the purest of the metals, there are some properties of copper that are not generally understood by the welder.

### Copper and Oxygen

Thus while copper resists atmospheric oxidization to a marked degree, many articles being still in existence which were manufactured 6,000 years ago, it will take up considerable amounts of oxygen when in the molten state. In the copper refineries, most of this oxygen is removed during the process of "poling" the molten copper in the large reverberatory furnace. However, the poling is discontinued at the proper time so as to leave .03 to .07 per cent oxygen in the form of cuprous oxide. Copper cast from such a furnace constitutes by far the larger part of the copper of the industries. It is known as "tough pitch" copper or more frequently as electrolytic copper, taking the latter name from the electrolytic refining process immediately preceding the final melting.

The small amount of oxygen in the copper in the form of cuprous oxide is beneficial rather than otherwise when the copper is to be used for electrical purposes, cold worked or cast into shape. But it is quite deterimental from the standpoint of the welder. Mr. S. W. Miller, whose work has been of such great value to this Society and to welders generally, gives an excellent exposition of this weakening effect of the cuprous oxide.[3]

Mr. Miller says, "The action is really two-fold, as was clearly brought out by a microscopic examination:

"(1) The thin melted zone just next to the V recrystallizes when cooling, and any oxide present collects at the grain boundaries, weakening them and therefore the metal.

"(2) Such of this oxide as is exposed to the action of the envelope flame is reduced to copper, which, occupying less space than the oxide, leaves spaces along the grain boundaries, weakening the metal still more."

In regard to the latter action, it is quite possible that the hydrogen by reason of its remarkable diffusive properties may reduce the oxide in the solid metal several thousandths of an inch back from the contact surface forming superheated water vapor which, by reason of its inability to diffuse outwardly tends to enlarge the space between grains.

Briefly then, the welder must either allow for this weakening effect of the cuprous oxide by a suitable increase in the contact area or he must use an oxygen-free copper. The latter is available as a standard product of nearly all of the manufacturers of copper bars, sheets and tubes being sold under the general name "Deoxidized copper," described more fully in a later paragraph.

### Heat Conductivity of Copper

Another property inherent in the copper which offers even greater difficulty to the welder than the content of cuprous oxide, is the high rate at which heat will flow through copper. This property, of course, makes copper eminently desirable for use in the manufacture of heat exchangers, such as boiler tubes, evaporators, radiators, cooling coils, etc.

We may add parenthetically that this property of copper enables the bank officials to outwit the welder-gone-wrong, who tries to cut through the bank vault with the cutting torch—it would take him too many precious hours to soak enough heat in the thick copper sheath of the bank vault to burn his way through to the valuable hoard inside.

There is no easy way to overcome this handicap in the welding of copper. Precautions can be taken to conserve the heat in the metal by covering the surface with asbestos, but a larger input of heat must be used than is the case with steel or cast iron. Also, owing to the extremely rapid transfer of heat through the copper, it is necessary to have the metal back from the weld at a much higher temperature than with the ferrous metals. A preheating is often necessary to fulfill this condition.

### Deoxidized Copper

The difficulty encountered in securing a strong bond with

*Paper presented at Fall Meeting, A. W. S., Cleveland, September, 1929.

†Testing Engineer for the American Brass Company.

[1] As an illustration of this rapid increase, Mr. Wm. G. Schneider in a paper read at the Meeting of the American Society Mn. & Met. Engrs., Nov. 22, 1928, stated that the consumption of brass pipe had increased from 16,821,400 lbs. in 1923, to 62,934,000 lbs. in 1927, with an estimated amount of 75,000,000 in 1928, or an increase of 345 per cent in 5 years.

[2] The welding of Brass and Bronze published in the March, 1929 issue of the Welding Engineer.

[3] "Oxy-acetylene Welding of Copper," by S. W. Miller, published in the Journal of the American Welding Society, for March, 1926

electrolytic copper, points to the use of an oxygen-free copper. This can readily be obtained by remelting the electrolytic copper and adding a deoxidizer in amounts sufficient to react with all of the oxygen. The agents commonly employed for this purpose are phosphorus, silicon, manganeze, zinc, cadmium and calcium boride. Since it is not possible to predict the exact amount of oxygen in the molten copper, an excess of the deoxidizer is usually added, a small amount remaining in the copper. (In the case of the calcium boride or the suboxide of boron, the excess floats off in the slag.)

For most purposes, an excess of the deoxidizer does no harm and is decidedly beneficial to the welder, but where the electrical conductivity is a requirement, extreme care must be exercised. A very slight percentage of phosphorus, for instance, remaining in the copper, may cut the electrical conductivity down to a fifth of its normal value. The heat conductivity is likewise cut down by the presence of the deoxidizing metal though it is usually high enough to give trouble to the welder.

### Welding Rods for Copper

A great deal of time and effort has been wasted in trying to overcome the difficulties encountered in the welding of copper by the use of various alloys, some of them quite expensive as, for instance, those carrying silver up to 5 per

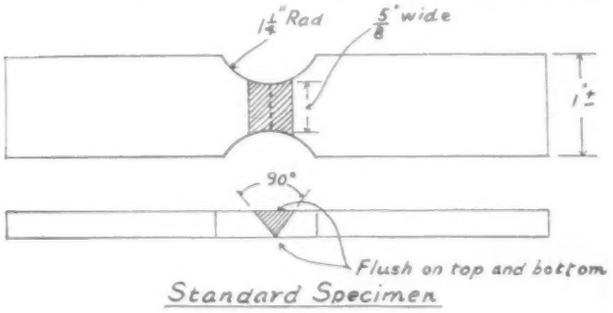



Fig. 1.

cent. It is desirable, of course, for the welder to use a welding rod stronger than the base metal. It is a reflection on his judgment if failures are constantly occurring in the deposited metal. However, an adequate strength is obtained by using a phosphor bronze, a silicon copper, silicon-manganese copper or, if a difference in color is allowable, a lower melting yellow bronze, brazing spelter or silver solder.

### Hardened Copper

It can be said, of course, that where we have manganese and nickel soluble in copper in all proportions and silicon, cadmium, aluminum, phosphorus, tin and zinc soluble in proportions of from 1 per cent to 10 per cent or more that we can have an indefinitely large number of alloys. This is true, even if we exclude the tin and zinc and restrict the alloying metals to a maximum of 4 per cent. It must be understood, however, that the bringing into production of any one alloy is preceded by an infinite amount of painstaking work. A great many disappointing heats and unsatisfactory trials are encountered before it becomes a commercial realization. For this reason we shall confine our attention to a comparatively few alloys.

Copper being relatively soft and ductile, the addition of nearly all metals soluble therein gives it a decided increase in hardness. Tin or cadmium, for instance, both extremely soft metals, exert a marked increase in the hardness of the copper even in amounts of 1 per cent or less. Hence, when sufficient of the alloying element is added to secure the desired effect we may say that we have hardened copper.

### Composition and Physical Properties

The alloys discussed in this paper with their outstanding properties may be stated thus:

| | Alloy | | | |
|---|---|---|---|---|
| Property | Tough Pitch or Electrolytic Copper | Deoxidized Copper | Hardened Silicon-Manganese Copper Alloy† | Copper Silicon-Nickel Copper Alloy‡ |
| Composition | | | | |
| Oxygen | .03 to .07 | .00 | | |
| Silicon | | .03 to .15 or | 3 | .80 |
| Manganese | | .03 to .15 or | 1 | |
| Nickel | | | | 3.2 |
| Cadmium | | .10 to .50 or | | |
| Phosphorus | | .03 to .10 | | |
| Copper | Rem. | Rem. | Rem. | Rem. |
| Specific Gravity | 8.9 | 8.9 | 8.45 | |

†Copper-Manganese-Silicon alloy is a patented alloy manufactured by the American Brass Company, under the name "Everdur."

‡Copper-Nickel-Silicon alloy is a patented alloy manufactured by the American Brass Company, under the name of "Tempaloy."

| | Alloy | | | |
|---|---|---|---|---|
| Property | Tough Pitch or Electrolytic Copper | Deoxidized Copper | Hardened Silicon-Manganese Copper Alloy | Copper Silicon-Nickel Copper Alloy |
| Tensile Strength, lb. per sq. in. | | | | |
| As Cast | 28,000 | 30,000 | 45,000 | 40,000 |
| Forged | 33,000 | 35,000 | 55,000 | 50,000 |
| Cold Worked | 60,000 | 65,000 | 130,000 | 120,000 |
| Welded | 15,000 | 30,000 | 45,000 | 40,000 |
| Coef. of Lin. Expans. per Deg. C. | .0000177 | .0000177 | .000018 | |
| Heat conduc. Cal. per sq. cm per cm. th per sec. per deg. C. | .0910 | .8 to .2* | .063 | .45 to .18† |
| Elec. Conduc. at 20 Deg. C. Per Cent IACS | 99 to 101 | 20 to 90‡ | 6 to 7 | 20 to 50 |
| Melting Point, Deg. F. | 1,981 | 1,981— | 1,868 | 1,981 |
| Melting Point, Deg. C. | 1,083 | 1,083— | 1,020 | 1,083 |

*A copper carrying .63 phos. has a heat conductivity of .251. In the same units mild steel has a heat conductivity of .117; pure iron .148 and silver 1.00.

†Estimated.

‡A copper carrying .034 per cent P. has an electrical conduc. of 80 per cent IACS; a copper carrying .043 per cent Silicon has an electrical conduc. of 86 per cent IACS; a copper carrying .075 per cent Mn. has an electrical conduc. of 91 per cent IACS; while copper carrying .017 and P .93 per cent Zn.

The welding characteristics of these various alloys have been brought out step by step in a series of exhaustive tests, the results of which are given herewith.

### Shape of Specimens

These were standardized to give us a convenient size to

weld and test. They were welded in the 1-in. width and machined, as indicated in the sketch, in order to give a maximum stress in the section along the axis of the weld. The difficulties encountered in welding long seams would be avoided in this type of specimen. All welds in material ⅛-in. or greater in thickness were welded from one side with a 90 deg. V-groove. Thinner samples were simply spaced apart 1/32-in. and butt welded.

**Welding Characteristics of Electrolytic Copper**

**Series 1:** Welds made on electrolytic copper (analyzing .0493 oxygen, .0019 sulphur, and 99.939 per cent copper plus silver), using Tobin Bronze welding rods with different conditions of the oxy-acetylene flame, i.e., reducing, neutral and oxidizing. Borax flux, 90 deg. V-groove. Averages of three tests in each case are shown below.

| Size Tested, Inch | Tensile Strength Per Sq. In., Lbs. | Flame, Remarks |
|---|---|---|
| .240 × .627 | 20,130 | Reducing, excess acetylene. |
| .251 × .628 | 19,300 | Neutral flame. |
| No tests | | Oxidizing. Bronze cannot be made to adhere. |

The fracture occurred in the electrolytic copper a few thousandths of an inch back from the contact surface.

**Conclusions:** The oxidizing flame was out of the question as the bronze could not be made to adhere. The reducing flame showed a slight improvement over the neutral flame but not sufficiently better to warrant departure from normal practice. Hence, except where stated otherwise, all other welds reported below were made with the neutral flame.

**Series 2:** Welds made on electrolytic copper, as above, in order to determine the strength of welds made with various welding rods. Oxy-acetylene torch. Borax flux. All of the results are averages of three to ten tests.

| Welding Rod | Size Tested, Inch | Tensile Str. of Weld, Lb. per Sq. In. | Fracture, Remarks |
|---|---|---|---|
| Tobin Bronze | .251 × .628 | 19,300 | 100 per cent in copper base. |
| | .072 thick | 24,880 | 100 per cent in copper base. |
| Mang. Bz. | .215 thick | 14,100 | 100 per cent in copper base. |
| | .072 thick | 22,770 | 100 per cent in copper base. |
| 5 per cent tin | .240 × .625 | 17,000 | 97 per cent in copper, 3 per cent blowholes in added metal. |
| Phos. Bz. | .072 thick | 19,120 | Mostly in base metal. |
| .50 Silicon .50 Nickel 99.0 Cu. | .245 × .610 | 17,870 | 100 per cent in copper base. |
| 3.50 Si. .15 Mang. 96.29 Cu. | .245 × .612 | 16,850 | 100 per cent in copper base. |
| 3.03 Si. 1.05 Mang. 95.85 Cu. | .253 × .629 | 15,300 | 100 per cent in copper base. |
| 1.10 Si. .36 Mang. 98.51 Cu. | .243 × .628 | 15,770 | 100 per cent in copper base. |

Conclusions: The above series embraces a comprehensive trial of welding rods. The results, therefore, show conclusively that we cannot expect electrolytic copper to develop more than 14,000 or 15,000 lb. per square inch, no matter what type of welding rod is used. The weakest part of the weld is in the base metal immediately adjacent to the V.

**Series 3:** In order to determine the effect of different gases and methods of welding, tests were made on electrolytic copper, using the oxy-hydrogen torch with excess hydrogen, the carbon arc and the metal arc; 90 deg. V-groove welds, fused borax flux. Results are averages of three (3) to six (6) tests in each case.

| Welding Rod | Size Tested, Inch | Tensile Str., Lb. per Sq. In. | Remarks |
|---|---|---|---|
| 3.03 Si. 1.05 Mn. 95.85 Cu. | .207 thick | 16,780 | Oxyhydrogen flame with excess hydrogen. Fracture 100 per cent in base metal. |
| 3.03 Si. 1.05 Mn. 95.85 Cu. | .200 thick | 19,505 | Melted with carbon arc. Fractures in base metal. |
| 3.03 Si. 1.05 Mn. 95.85 Cu. | .257 × .632 | 17,170 | Carbon arc, no flux, straight polarity, 5/32 in. dia. rod 180 amp. Fracture largely in added metal. 20 per cent of cold shuts and voids. Necessary to preheat copper to start the weld. |
| .24 Si. .024 Phos. 99.635 Cu. | .253 × .627 | 18,670 | Metal arc 5/32 rod 200 amp. No flux. Fracture largely through added metal. 19 per cent of shrink cavities and voids. |
| None | .233 × .372 | 28,670 | Resistance butt welds. |

The above welds do not represent the maximum values that can be obtained with any one method of welding since the man making the welds could not be kept on any one method long enough to develop a technique which would give maximum results. The results, however, do show quite conclusively several things:

(1) It is practicable to weld electrolytic copper with any of the above methods, the oxy-acetylene torch, the carbon arc or the metal arc. With the latter method a certain amount of preheating is necessary to start the weld.

(2) Provision must be made by way of increasing the contact area in order to develop the full strength of the base metal. This can be done as in Fig. 2, with the "Shear V," the "wide angle" or the reinforced weld.

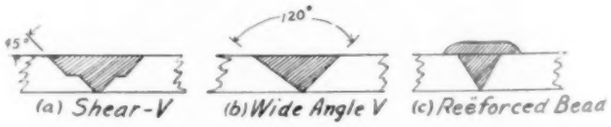



FIG. 2

(3) A resistance butt weld seems to develop nearly full strength. A careful microscopic examination of a number of these welds shows a web of copper oxide-copper eutectic along the contact plane. The cuprous oxide is distributed so finely as to lower the strength from that of dead soft copper only slightly.

(4) Following the general principle that the best two satisfactory welds is that one made with the least heat, we would select the Tobin or manganese bronze rods first, wherever it was permissible to use a high zinc mixture. Where it is necessary to use the arc, the yellow bronzes are unsatisfactory and the silicon-manganese copper seems to offer the best characteristics for a welding rod.

(5) Though the tensile tests do not disclose the correct value of the welding method in making sound welds, the writer watched these tests very closely and is convinced that the use of the oxy-acetylene torch and the carbon arc are very much more reliable in producing welds free of blowholes than is the metal arc.

### Welding Characteristics of Deoxidized Copper

A series of tests paralleling those on electrolytic copper given above were run on copper deoxidized with various elements. Average results of these tests are given below:

Series 4: The object of this series of tests was to determine the effect of various welding rods on copper deoxidized, as indicated in the tabulation.

| Welding Rod | Size Tested, Inch | Tensile Strength per Sq. Inch, Lbs. | Remarks |
|---|---|---|---|
| Base Metal, .15 Si., .09 Mn., .99.77 Cu. | | | |
| Same as Base Metal | .070 × .691 | 23,220 | Oxy-acetylene welds, borax flux. Fractures in weld metal. |
| .24 Si., .024 Phos., Rem. Cu. | .0679 × .629 | 25,130 | Ditto. |
| 2.85 Si., 1.05 Mn., Rem. Cu. | .065 × .640 | 29,690 | Oxy-acetylene welds, borax flux. Fractures in weld metal. |
| 2.85 Si., 1.05 Mn., Rem. Cu. | .0791 × .747 | 30,150 | Oxy-actylene weld, $\frac{1}{4}$ inch dia. welding rod laid on joint and fused. Samples not machined. All fractures in the base metal adjacent to the bead. |
| 2.85 Si., 1.05 Mn., Rem. Cu. | .0678 × .673 | 27,570 | Carbon arc weld. $\frac{1}{4}$ inch rod laid on joint and fused. Samples machined. Fracture in weld metal. |
| .24 Si., .024 P., Rem. Cu. | .0701 × .646 | 24,170 | Ditto. |
| Same as Base Metal | .0678 × .675 | 23,550 | Ditto. 15 per cent of voids in fractures. |
| Base Metal, .020 Phos., 99.909 Cu. | | | |
| 5.00 Sn., .04 Phos., Rem. Cu. | .212 thick | 23,360 | Oxy-acetylene welds. Borax flux. Fractures in welds. |
| 5.00 Sn., .04 Phos., Rem. Cu. | .073 | 26,700 | Ditto. |
| Tobin Bronze | .212 | 31,900 | Ditto. Except most of fractures in base metal. |
| Tobin Bronze | .073 | 31,040 | Ditto. |
| Mang. Bronze | .212 | 32,460 | Ditto. |
| Mang. Bronze | .073 | 31,200 | Ditto. |
| Tobin Bronze | .242 × .618 | 36,100 | Ditto. Fractures 100 per cent in base metal. |
| 3.03 Si., 1.05 Mn., 95.85 Cu. | .253 × .638 | 34,270 | Ditto. Except no flux used and fractures partly in weld. |
| Base Metal, .085 Si., 99.831 Cu. | | | |
| 3.03 Si., 1.05 Mn., 95.85 Cu. | .245 × .627 | 25,570 | Oxy-acetylene welds. Borax flux. Low strength probably due to running metal too cold. |
| 5.00 Sn., .04 Phos., Rem. Cu. | .250 × .627 | 21,100 | Ditto. |
| Tobin Bronze | .250 × .624 | 34,830 | Ditto, except fractures 65 per cent in copper and remainder in weld metal. |
| 1.10 Si., .36 Mn., 98.51 Cu. | .240 × .624 | 28,830 | Ditto, except fractures which were mostly in weld metal. |
| .24 So., .024 Phos., 99.635 Cu. | .270 × .628 | 16,770 | Carbon arc welds. No flux. Techincally not thoroughly worked out. Higher strengths are possible. |
| 3.03 Si., 1.05 Mn., 95.85 Cu. | .257 × .628 | 26,270 | Ditto. |
| None | .229 × .373 | 25,140 | Resistance butt welds. Two tests only. Technique not thoroughly worked out. Higher strengths are possible. |
| Base Metal, .020 Phos., 99.909 Cu. | | | |
| None | .230 × .372 | 29,600 | Resistance but welds. Fractures mostly in welds. |

As in the case of the electrolytic copper, the above results on deoxidized copper are not maximum results possible but are sufficiently representative to enable us to draw some definite conclusions, thus:

(1) The phosphorous deoxidized, the silicon deoxidized and the silico-manganese deoxidized coppers are all readily welded with nearly equal facility.

(2) With a given welding rod, the full strength of the deoxidized copper can be developed without resorting to a reinforcing bead.

(3) The highest strength of joint is developed using a high zinc yellow bronze. With this welding rod the base metal need not be fused. The 3% si.—1% mn., Rem. Copper welding rod can also be applied without fusion of the base metal.

(4) The oxy-acetylene torch and the carbon arc both give good welds. The metalarc is possible but the resulting welds are more porous than with the first named methods and a certain amount of initial preheating is necessary.

## CHICAGO SECTION PLANS PROGRAM OF DEMONSTRATIONS

The American Welding Society Chicago Section, has adopted an interesting and unique plan for its program of local meetings for the coming year. Previous meetings have been confined principally to the reading and discussing of technical papers. There is, however, a considerable amount of very good welding talent in the Chicago district and the Program Committee is taking advantage of this fact to give all those who attend the meetings some opportunity to see some of the best welders in the district demonstrate their ability. It is, therefore, planned to have a demonstration of one type of welding as a part of each monthly meeting for the 1929-1930 season. The first meeting of this kind was held Thursday evening October 3rd. Arrangements were made with the Greer School of Electricity and Automotive Engineering in Chicago, which is equipped with oxy-acetylene and electric arc welding apparatus, lecture rooms and equipment for showing lantern slides and motion pictures.

The technical paper read at this meeting was a paper on the Welding of Aluminum and Aluminum Alloys prepared by Mr. Wm. A. Dunlap, Metallurgical Engineer of the Aluminum Company of America. This is the first paper on the subject of aluminum welding which has ever been presented at a Chicago Section meeting. The paper discussed the welding of pure aluminum and aluminum alloys by all the welding processes and for both production or repair work. Consequently, it was of great interest to men in many lines of welding. In fact, the interest was so high at the meeting that the discussion started before the paper was finished. Following the discussion there was a demonstration of bronze welding cast iron in the vertical and overhead position and building up of bronze on cast iron in a flat position by Mr. R. P. Monroe of the Burlington Railway. The demonstration showed the quality of the work which can be done by a skilled operator and was enthusiastically received by all those who were present. There is little doubt in the minds of the directors of the Chicago Section regarding the success of the meetings for the next seven months. The combination type of meeting promises to draw a large attendance and be productive of good results for the local firms interested in welding.

## CONVENTION WILL FEATURE STRUCTURAL WELDING WITH THE TORCH

One of the outstanding features of the program which has been prepared for the meeting of the International Acetylene Association which is to be held at the Congress Hotel, November 13-15 is a special session on the subject of welding structural steel by the oxy-acetylene process. The building recently completed at Niagara Falls will be discussed from several different points of view and motion pictures of its construction will be shown during that session. Special attention will also be given to the subject of welded piping which is attracting considerable attention in the oxy-acetylene industry at this time. There will also be considerable discussion of the use of welding in aircraft construction and papers on this subject will be presented by some of the best authors in the country. There are also a number of papers of great fundamental importance which have been prepared especially for this meeting and which will add materially to the literature of the oxy-acetylene industry. The program promises to be full of worth while sessions and all those interested in the progress which the industry is making will be benefited by being present. Hotel reservations can be made by writing direct to the Congress Hotel, or by writing Mr. Chas. Schuh, Carbide and Carbon Building, 230 N. Michigan, Ave., Chicago.

# Training Aircraft Welders

## Welding Supervisor of Alexander Aircraft Corporation Prefers to Take Inexperienced Men and Train Them for This Work

"IT takes more than a year, on the average, to train a man to such a point that he can accomplish 100 per cent efficient work in the welding department of an aircraft company," explained A. Noel Damours, supervisor of the welding department of the Alexander Aircraft Company, Colorado Springs.

In the production season Mr. Damours has as many as 21 welders at work, and, strange to say, the delicacy of the work in the construction of airplanes is such that not many welders, expert in other lines of the industry, are capable of tackling this work with any degree of immediate success. There are some handicaps. One of them is the necessity of being somewhat of a contortionist, for, in the construction of an airplane fuselage, it is necessary to almost stand on one's head to reach certain points where a good weld is absolutely vital for the safety of those who are to fly.

Much of the work is done while the skeleton of the fuselage is set up in a jig—not at a bench—and the worker frequently must partially crawl through the framework in an effort to reach inside points. Sometimes he is flat on his back with his legs dangling down outside. Yet, a visit to the welding department of this company will disclose many of the welders so accustomed to working in unusual positions and under many difficulties that they are able to smoke a cigarette and weld at one and the same time from almost any physical position.

Many welders, experienced in other lines of the trade, would not be able to do this without much practice because they aren't as young as they used to be.

Another handicap is the delicacy of the work. At least 75 per cent of the work is done with five ounce torches and rods one-sixteenth of an inch in diameter. It is nerve racking to the beginner to hold the point of the rod and the point of the flame in a small area for long at a time. It is just as nerve racking to the experienced welders who come into aircraft work.

Many welders may consider these so-called handicaps as pure bunk but in substantiation of what he says about it, Mr. Damours cited the instance wherein a welder of years of experience—14 years—admitted that it was too nerve racking for him, and he pulled out after trying for a month to change his habits. Another welder of 10 years of experience did the same thing.

"In most types of welding it is unnecessary to confine the flame and the rod in a small area," Mr. Damours explained. "The workers use large rods and large torches and cover a wide spot with torch in order to keep a large area well heated. To do this, they keep the torch in motion and acquire a sort of circular movement which becomes somewhat of a habit. If for any reason they should be slightly nervous some morning, it will not affect the work in this respect.

"Therefore we find that many experienced welders who have come to us have difficulty in changing their habits. Some never do, while others take so long that they cannot be efficient one hundred per cent in less than two or three months.

"It isn't because we don't want expert welders from other lines in our shop that we prefer to take young men and train them ourselves, but because we have found that experienced men are a losing proposition for several weeks and some finally give up in despair and go back to the heavier types of work. In such instances we have lost what we have thus far invested in them."

Mr. Damours has been singularly successful in training welders for aircraft work, according to the officials of the company and others. And, since it requires at least a year to make an expert worker, it is not surprising, then, that he is very particular in selecting his men.

In many departments of aircraft building, men of a quick, nervous temperament are best. Not so in the welding section. Mr. Damours prefers what he terms a "placid type" of man—slow, plodding, steady. He prefers men who have had a little experience in a machine shop—not necessarily a welding shop—because they have had some experience in handling tools and machinery and know what it is all about. He prefers men between the ages of 25 and 35. He doesn't want youngsters, however, because they haven't had shop experience, haven't been "fired" enough to know what work actually is, and they require a lot of superfluous supervision.

We shall assume that the applicant has the necessary qualifications.

His first work will be somewhat of the roustabout nature such as taking care of scrap materials and milling tubing—in order to become familiar with the metals he will have to work with. But he is given about two hours practice a day with a torch—not all in a bunch, but in periods of 30 minutes each.

"I find that the beginner can stand only a few minutes of the nervous strain at a time," explained Mr. Damours. "The strain comes from his endeavor to hold two small points together on a small spot. Unfamiliarity with his working tools also contributes to the strain.

"As he gradually overcomes the strain, I increase the length of time he is permitted to handle the torch until eventually he will be able to put in an eight hour day at welding. It takes the average man a couple of months to overcome the nervous strain.

"His first experience with the torch is that of welding scrap tubing or making long rods out of discarded short lengths. Though the beginner may be set to tying short lengths of rod together into workable lengths, we do not find it a saving to use such rods in the regular work. The beginner may use the rods on some of the practice tubing welding he undertakes.

"At this point I might explain why we do not find it economical to use these spliced rods in the regular work. At each joint a certain amount of oxidation took place when the weld was made. These spots delay regular work, for the welder must, with his torch, delay long enough to remove oxidized portion from the joint he is welding. Since most of the rods are one-sixteenth of an inch in diameter it takes many four-inch lengths to equal a pound. We timed a worker once, to determine whether or not we could make a saving, and found that he earned only 26 cents an hour. This did not take into consideration overhead or the cost of the gas used in the operation. So it is really cheaper to throw away the short lengths and use only long lengths in the general operations.

"As the worker progresses, he is given jobs of welding where the strength element is not vital. We have a hundred and one things to weld in our department. Many of them are simple and the safety factor, in so far as an airplane

flight is concerned, is not important—no lives would be lost if the weld should fail.

"I also find it best to let the students specialize on types of work until they have become proficient in them, gradually working them into the more complicated and more difficult types until eventually they are capable of accomplishing the difficult, delicate and vital work of putting a fuselage together.

"It takes three months before the average student is ready to go on better work. In ten months or a year he is able to do 75 per cent of the kinds of work we have to do, and more than a year to be 100 per cent efficient."

Mr Damours' department is laid out in the most modern manner and especially well arranged for aircraft work. The gas is generated in a small building located 50 feet from the factory building and the exterior wall of the welding department. The little building is 15 by 20 feet and in two sections. On one side is the carbide generating plant and on the other side the oxygen tanks which are hooked up in two series of five cylinders which in turn are joined by valves at the main line so that the whole ten may be operating at once, or only five of them.

Where the two main lines enter the building there is a series of three flash backs to keep any flame from getting back to the generating plant. From the flash backs the pipe lines run overhead at an elevation of 9 feet above the floor. The main lines run down the center of the department and branch lines spread out at right angles on both sides at 17 foot intervals.

From the branch lines short lengths drop down to within 7 feet of the floor to the pet cocks, which are therefore within easy reach of any workman standing directly on the floor.

From the regular equipment, 34 torches may be operated at one time, but by the use of special fixtures at each station, the number of torches may be increased.

For aircraft work, it is better to have the overhead lines, according to Mr. Damours because they increase the mobility of the hoseline and torch in reaching any and all parts of an airplane fuselage. And to further increase this mobility, the hose lines are 25 feet in length.

## OXWELD ADVERTISEMENT WINS AWARD

At the annual convention of the National Industrial Advertisers' Association held at the Hotel Gibson, Cincinnati, September 30th, October 1st and 2nd, Union Carbide organization was honored by the award, to the Oxweld Acetylene Company, of the trophy for the best individual trade paper advertisement in the exhibit. This advertisement, in which layout and copy are so well combined, is shown on this page and was prepared by the Technical Publicity Department. It appeared in the March, 1929, issue of The Welding Engineer. The tapering design built up of a photograph of the Oxweld Type W-1 welding blowpipe carries the eye down to the Oxweld trademark, which gives a most effective balance. The dramatic sweep of the diagonal line compels attention and the reputation of the diagonal in the border decoration and the outline of the copy, all contributing to the effectiveness of the advertisement. One feels the weight of years of experience and experiment behind the copy, which adequately holds the attention attracted by the layout. In addition to this award, six advertisements of the current series on Prest-O-Weld welding and cutting apparatus were given the distinction of second prize in the contest for the best series of not less than six advertisements featuring performance.

This meeting was attended by several hundred industrial advertising executives from all sections of the country. Over 190 panels, each bearing from 10 to 18 advertisements were exhibited, the largest industrial advertisers and advertising agencies in the country participating. The exhibit involved also a competition for 14 varying types of awards. In discussing the advertisements exhibited, the judges also commented favorably on the series of the Haynes Stellite Company and a series of six advertisements on the Electro Metallurgical Sales Corporation. The trophy will hang in the offices of the Technical Publicity Department of the Union Carbide and Carbon Corp., Bartholomew Building, New York City.

"Oxweld carries on
when the others
quit . . ."
A STUDENT engineer characterizes the above phrase as "my simplest way of expressing the reason for my choice of Oxweld equipment as being superior to others." This young man had just completed his curricular requirement in oxy-acetylene welding and cutting at a prominent engineering school. Ninety-two per cent of his classmates also chose Oxweld.
There is a similar marked preference for Oxweld in industry. The reason is economic. Oxweld blowpipes, embodying the Oxweld low-pressure injector principle, give more welding, more cutting, more hours, months and years of operation. They carry on when the others quit.
Reliable—Economical—Long-Lived
Typically Oxweld
OXWELD
WELDING AND CUTTING APPARATUS AND SUPPLIES
OXWELD ACETYLENE COMPANY
Unit of Union Carbide and Carbon Corporation
NEW YORK Carbide and Carbon Bldg.
UCC
CHICAGO Peoples Gas Building
SAN FRANCISCO Adam Grant Building
STOCKS IN 38 CITIES

The Prize Winning Advertisement.

## NEW WELDING SCHOOL IN SYRACUSE

A school for electric and acetylene welding has been started in Syracuse to be known as the National Welding School. Mr. Leitz of Buffalo, who has a number of years in the trade school work will be associated with Mr. Blixt of the Blixt Welding Works.

They have leased a building with 1200 square feet floor space on 424 S. West street, Syracuse, and are installing motor generator sets, alternating current machines, and also spot welders.

They have purchased from the K-G Welding and Cutting Company two fifty-pounds generators for acetylene and ten welding outfits.

Enrolled at the present time they have fifteen students. The course covers five weeks, both night and day classes. Competent instructors have been engaged and all branches of the trade will be given. Living arrangements for out of town students will be secured at a nominal cost.

# Arc Welding Thin Sheet Metal

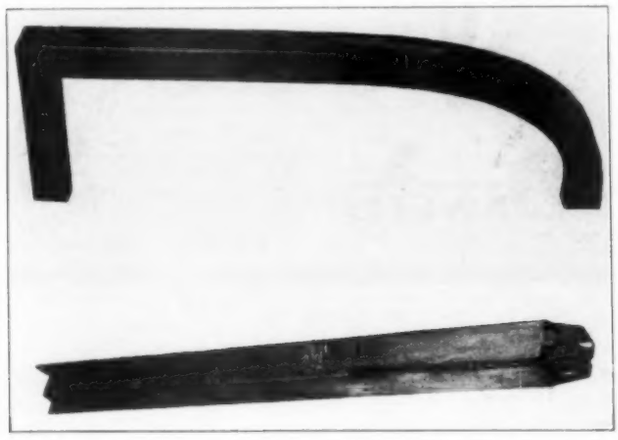
## New Carb-O-Flux Process Has Been Developed for the Purpose of Using the Electric Arc on Thin Sheets—What It Is and What It Does

By J. B. Green*

THE welding of thin sheet metals has occupied the attention of development engineers and research laboratories for years. Progress was first made by the oxy-acetylene process. Then resistance processes began to appear and spot, seam and flash welding have now reached high states of development. There has been an insistent demand for an arc process suitable for welding thin sheets for a very long time, but until recently comparatively little progress has been made. Eventually each process will probably find its own peculiar field of application. There are four items to consider in selecting any particular process. These are the quality required, the production cost, the capital investment in equipment and the number of articles, all alike, to be produced in a unit time.

### Requirements of Suitable Process

Back of all this, however, is the fundamental question of whether the process is inherently suitable to the welding of thin sheets. Everyone knows that there is really nothing in the world exact. No foot rule is exactly a foot long. The rules which we are all in the habit of using are merely near enough

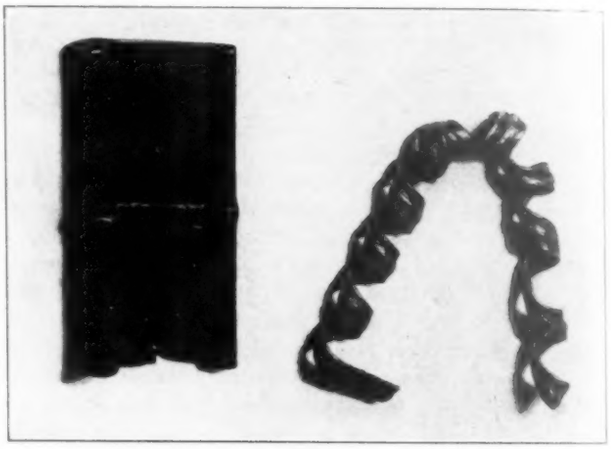


**ABOVE—Roll top desk arm of 16 gauge steel showing a section at the right Enamel finished, then a short section in the center with the weld bead ground off preparatory to finishing and the remainder as welded.**
**BELOW—Desk leg of 18 gauge before grinding the bead off.**

to an exact foot for all practical purposes. No one would consider using a foot rule to measure thousandths of an inch. A micrometer is necessary. In welding by any process, there is a variation in the heat as welding proceeds. When welding on heavy metals, this heat variation is but a small fraction of the total heat involved and the variation, as such, usually goes by unnoticed. However, as an attempt is made to weld thinner materials, the variation becomes an increasingly important factor and finally, in some processes, precludes their application. Thus, the matter of welding thin sheets is very largely one of precision heat control. If too little heat be applied, the sheets will not be fused together. On the other hand, if too much heat is applied, the sheets will be burned through. Limits of variation are thus set and if, during the welding process, the range in heat variation is greater than that required to insure fusion and that which results in burning through, the process is not suitable. Naturally, the thinner the sheet the narrower is the allowable range of heat variation. Practically everyone interested in the general subject knows these things, but very few think of them in just this way.

*President, Fusion Welding Corporation.*

So far there has been developed no definite measure for heat variation during welding. However, if any process is considered from the viewpoint just described, much useless experimenting with unsuitable processes can be avoided. As an example, consider the metallic arc process. Here all of the filler material must pass from the electrode to the work through the arc in the form of drops. As each drop passes, there is a decided change in arc length. In fact, the accepted practice of holding a short arc involves extinguishing the arc each time a drop passes. This means that the arc length varies from zero, up. A wide variation in the heat developed from instant to instant is an inherent characteristic of the metallic arc process. On heavy work, this is almost unnoticeable because the heat in the weld itself and adjacent metal acts as a great reservoir and prevents rapid heat changes as



**CARB-O-FLUX ARC WELDED SPECIMENS.**
**Showing extreme weld ductility in 20 gauge Mild Steel.**

the drops pass. As a practical proposition, the limit of the metallic arc seems to be reached at about No. 14 gauge sheet steel. As a laboratory stunt, thinner sheets can, of course, be welded. Under certain conditions, lighter gauges can also be welded commercially when special equipment or copper chills, etc., are employed.

Rather than attempt to extend the application of the metallic arc into the field of thin sheet welding, it seemed to our engineers more logical to employ the carbon arc, thus eliminating the passing drops of molten metal with the consequent rapid variation in heat. Difficulty, however, is encountered from the very start. The carbon arc tends to pull off from the cold steel along the edges of the weld. The arc stream, of course, always follows the path of least resistance and if this path leads to the cold edges, the arc will naturally jump around in a manner which makes anything approaching precision control by the operator.

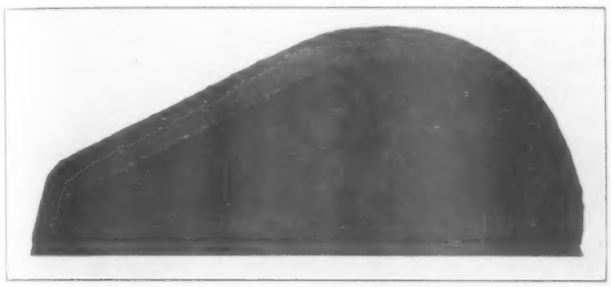
### A New Arc Process

Some years ago, the Research Laboratories of the Fusion Welding Corporation undertook to solve the problem. Their answer is simplicity itself, which is now available in the form of the new Carb-O-Flux Arc Welding Process. As the name implies, the process is a combination of a carbon arc and a suitably fluxed welding wire. The flux is designed, not only to protect the metal, but to generally steady the arc, and also insure the path of least resistance for the arc stream to in-

variably lie between the carbon point and the hottest spot which should always be the center of the weld. The process, as such, has been built up around this central characteristic. By proportioning the cross section of the welding wire to the thickness of the sheets being welded, an inch of weld seam can be laid down with an inch of wire. This obviates the necessity for either retarding the filler material or leading it as the arc passes over the seam. The operator merely has to lay down the wire in the seam as fusion proceeds. His entire attention can thus be given to maintaining a steady arc.

### Carb-O-Flux Filler Wire

A new series of sizes for the wire have been developed, which we call the Carb-O-Flux gauge system. Rather fine graduations of size are required to weld the various thickness of sheet and to accommodate the various types of welded joints, such as butt weld, lap weld and corner weld. The gauge numbers in the Carb-O-Flux system refer to the cross sectional area rather than to the diameter of the welding wire. For example, size No. 8 has exactly twice the cross sectional

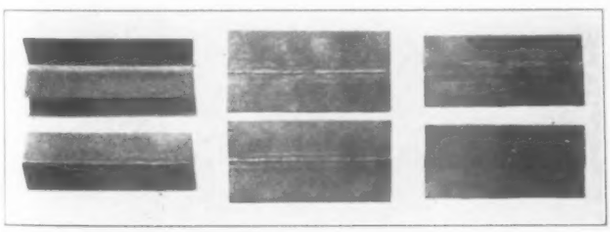


**CARB-O-FLUX ARC WELDED GEAR GUARD.**
**27" long, 10½" high, 3½" wide of 18 gauge Mild Steel.**

area of size No. 4. The wire is supplied in 27-inch lengths, which will produce exactly two feet of welded seam and allow the remainder as a stub end to be thrown away. This permits selling the wire by the "welding foot," rather than by weight, which makes it very easy to compute the quantity required for any specified volume of work, as well as to figure the cost of wire per thousand feet of seam.

### Special Equipment and Accessories

The new Fuzon Carb-O-Flux Welding Generator has been designed to be used especially with this process. Its use provides the precision heat control which the process requires. Special lead cables and holders are also available of very light



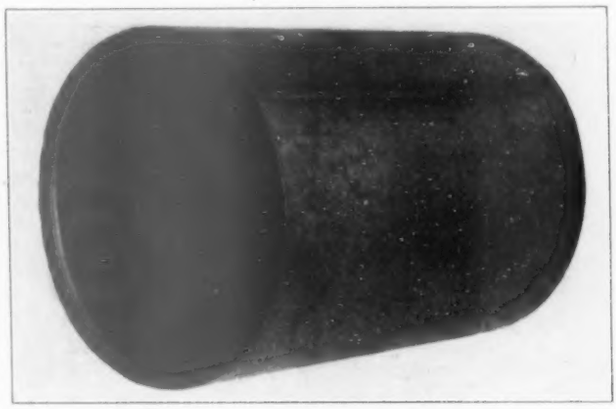
**SPECIMEN CORNER, BUTT AND LAP CARB-O-FLUX ARC WELDS.**
**Showing both sides of each, all Mild Steel, the corner weld being 18 gauge, the butt weld 22 gauge and the lap weld 20 gauge.**

weight so that the operator does not become fatigued in using them on light gauge work. The new Carb-O-Flux Dual Vision Helmet is also made for the process. This permits clear vision of the work up to the very instant of striking the arc, when an extremely small and almost unnoticeable tilt of the operator's head, completely eliminates the arc rays from the clear vision window and allows them to go through the window protected by welding lenses. Special Carb-O-Flux Gloves are also desirable, because they permit the operator to get the full two welding feet out of each wire. Other gloves require that longer stub ends than are necessary be thrown away.

### Properties of Carb-O-Flux Welds

The Carb-O-Flux Arc Welding Process permits welding sheet steel down to as light as No. 30 gauge. Carb-O-Flux welds are extremely ductile, readily taking cross beading. They also can be successfully enameled and where necessary to grind off the bead, this is removed more quickly and with less wear on the grinding wheels than is true in the case of some other welds. Furthermore, a skilful operator, by properly selecting the Carb-O-Flux gauge of wire, can lay down an extremely small bead, which, in turn, means still less grinding where finish must be obtained in this manner. Carb-O-Flux welds many metals. This method of welding is really a new trade. A steady hand is the prime requirement. Women seem especially adapted to the work, but it has been found best to employ a trained man as foreman. Teaching facilities are being established in various parts of the country for the training of foremen to take charge of Carb-O-Flux welding departments. About six weeks seems to be the required time for such a course in the case of most men already familiar with welding and having a good primary education.

The process is peculiarly adapted to mass production, because the principal advantage lies in the extremely high welding speed obtainable. Practice is invariably required to attain these high speeds and miscellaneous work never permits sufficient practice on any one job to allow the operator to come



**CARB-O-FLUX ARC WELDED SOUP KETTLE.**
**18" diameter, 25" high of 16 gauge Mild Steel.**

up to full speed. High speed application of the process not only reduces costs, but has another and very important, indirect benefit. In many applications, high speed actually increases the joint efficiency of the weld. This is not so noticeable in the case of mild steel as it is in connection with some alloy steels and also the nonferrous alloys. The structure of these other metals is often so altered through the heat of welding that it becomes weak in a zone adjacent to the weld itself. One of the characteristics of the Carb-O-Flux arc is the extremely narrow zone across which the heat is applied. The process, on this account, has a minimum tendency to affect the adjacent parent metal. If the welding is done at very high speed, the heat naturally has a much less tendency to spread and welds of very high joint efficiency result.

The process has been applied, as intimated in the preceding remarks, to metals other than mild steel. Aluminum and its super-strength alloys are readily welded by it. Copper is another metal which lends itself admirably to this type of welding. Many of the alloy steels, especially in the lighter gauges, seem best welded by the Carb-O-Flux process. The alloy containing 18% chromium and 8% nickel, which is highly resistant, both to corrosion and scaling at elevated temperatures, is now easily welded. Special fluxes must be designed for each one of these metals and alloys to produce the characteristic, steady Carbo-O-Flux arc and protect the metal completely during welding. The process bids fair to improve the manufacture of many articles made on a quantity production basis from sheet metals.

# Hints for the Welder

*WHEN YOU FIND a new way to do a hard job, or finish a particularly interesting weld, can you describe how the work was done? . . . . . Have you learned some little stunt every welder ought to know? . . . . . Write to us about these things . . . . . This department helps you welders to help each other. Write up your ideas any old way and just make rough pencil sketches . . . . We'll fix them up for publication.*

## RESHAPING CAST ALUMINUM DIES

The dies shown in the photographs are used in the shaping of the lids and bodies of musical instrument cases. They are all made of cast aluminum. Recently the manufacturer determined to make some changes in the design of one of the instrument cases. This required the reshaping of the aluminum dies. They are made in sets of four parts, the two smaller fitting into the two larger parts. It was planned to increase the size of the ends of the case one-half to three-quarters of an inch. In order to do this aluminum had to be added to the outside around the ends of the smaller dies. When this was done, they would be machined to their proper shape. The interior of the base die would have to be cut out to allow the enlarged inner die to fit properly. For this reason, it too, had to have metal added so that its strength would be maintained.

The three upper photographs show the location of the added aluminum on the two parts of the inner die. Great care had to be exercised in adding this metal. The casting was first thoroughly preheated. When it was at the proper heat the welder set to work with his torch and a steel paddle. He scraped off the surface oxide and then began the operation of adding aluminum filler rod just as in welding up a broken casting. Only a little of this was done at one time and the steel paddle was used frequently in working the metal and smoothing it out. Great care had to be taken in the control of the heat while work was progressing, because a little to much at any time would have caused the collapse of some of the thinner sections of the casting.

Making alterations in aluminum castings after they have been in use for some time is not an ordinary procedure but undoubtedly in some cases it is the economical thing to

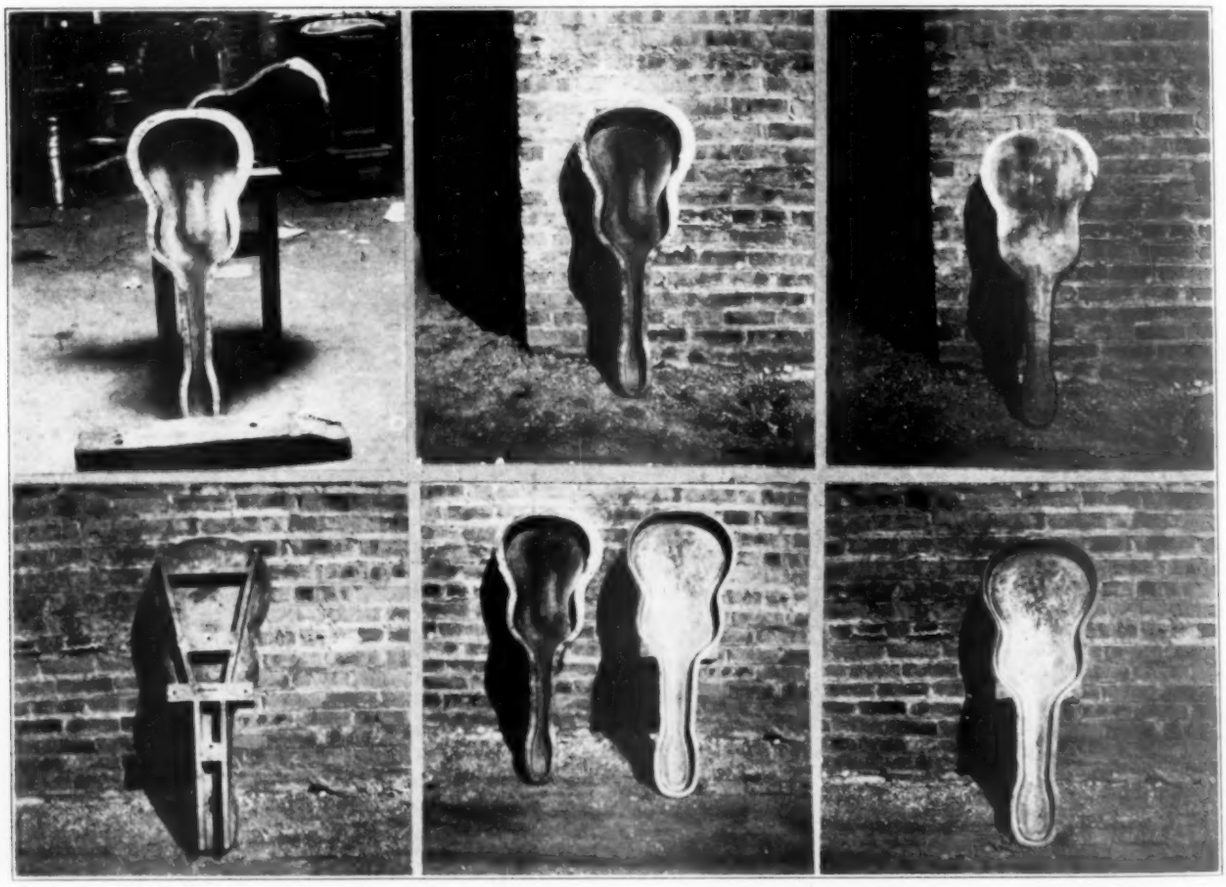


**Fig. 1. Note Amount of Metal Added to Outside of Inner Dies.**
**Figs. 2 & 3. Front and Back View of One of the Inner Dies.**
**Fig. 4. Back of Large Die. Note Heavy Ribs.**
**Fig. 5. Left Die Fits Into The Right Die.**
**Fig. 6. Front View of the Outer Die.**

do. When one considers the expense of having new patterns made, then just one new casting, as was true in this case, it can be seen that quite a saving was effected by having the changes made with the oxy-acetylene torch.

## MAKE TESTS ON ELECTRIC BUTT WELDING

### By T. L. Jarvis

**In "The Water Tower," Published by the Chicago Bridge and Iron Works.**

A series of tests were made recently on butt-welded steel specimens for the purpose of making observations on the strength and consistency of this type of joint. Little use has been made of the butt-welded joint in steel tank construction, though lap welding has been done for some time with considerable success.

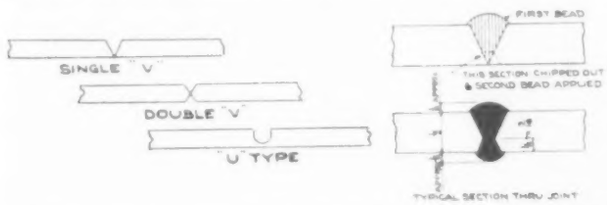
The first test was to determine the strength of a butt weld subjected to abuse. A one-half inch plate six feet square was cut through the center and the halves welded together. Then the plate was rolled both ways, directly and indirectly across the weld. The only apparent effect was a crack which appeared at one end of the weld and extended toward the center.

Test bars were cut from the plate containing part of the weld which appeared to be sound from the outside. Specimens were also cut from the metal on both sides of the weld to be used as a comparison and to see what effect the rolling had made on the steel.

Three welded specimens were pulled; the first developing an efficiency of 82 per cent, the second, 60 per cent and the third, zero. After the test it was evident that number three contained the crack which developed in the plate during rolling although not apparent from the outside. The rolling had no effect on the metal, all specimens having an ultimate tensile strength above 60,000 pounds per square inch.

The result of the test was good considering the abuse to which the plate was subjected and the poor penetration obtained by the welder, which was evident after fracture.

Another group of specimens was made with the object in view of making a butt-weld that was stronger than the metal or with an efficiency of 100 per cent. Three different




**The Three Ways of Preparing Specimens for the Butt Welding Test.**

types of joints were used: the single V, double V and cup or U type. All welding was done vertically. The joints were welded on both sides, with the weld material beaded about one-eighth inch above plate.

Nine specimens were tested, including three of each type. The fracture of each occurred in the weld. The highest efficiency obtained was 79 per cent; the lowest, 57 per cent. The efficiency of the double V type was consistently higher and appeared to be the easiest weld to make from the welder's standpoint.

The result of the second test was not very good considering the objective. Poor penetration was the cause of failure in the weld.

In order to be sure that the proper current and welding rod were being used, an expert was obtained from the Lincoln Electric Company to make a butt weld that would test 100 per cent. There were no limitations made as to specifications of the weld, the only requirement being to weld vertically.

The single V type joint was used and a current of 180-185 amperes with 5/32-inch welding rod. Two plates 9 in. x ½ in. x 3 ft. were welded together on one side in a vertical position with a continuous weld three feet long. The plate was then chipped out behind the weld to a depth of ⅛ to 3/16 inch and welded.

Ten specimens were cut from this plate and tested, five developing an efficiency of 100 per cent and the lowest 92½ per cent.

The result of this test showed that a butt welded joint could be made which would develop an efficiency of 100 per cent. It would require a bead on both sides and would have to be chipped out behind the weld to insure penetration throughout the entire section. It is also evident that a greater cross-sectional area is required through the weld than through the steel to develop equal strength. Therefore, it is necessary to have ⅛ to 3/16-inch welded material above plate to obtain this additional cross-sectional area.

After the specimens made by the Lincoln Electric Company were tested it was decided to have each welder in the Chicago plant make three specimens using the Lincoln specifications for two, and a single bead joint for the third.

Sixty specimens were made and tested, 40 of which were welded on both sides and 20 with a single bead. Thirty-two of the 40 double welded specimens tested 100 per cent. The lowest of the remaining eight was 72 per cent. Not one of the 20 specimens which were welded by a single bead tested 100 per cent. The highest efficiency was 81 per cent, the lowest 35 per cent.

It was evident throughout the test that the greatest factor involved was the human element. The secret of all welding is the penetration obtained. Without perfect penetration throughout the section a 100 per cent welded butt joint cannot be obtained. Therefore, it is imperative to weld both sides of the single V-type joint, chipping out plate on closed side after first bead is put on.

## NEW PROFITS IN THE AUTOMOTIVE FIELD

### Popularity of Fender Wells Opens New Field to the Automobile Welding Shop

NEW opportunities for the use of the oxy-acetylene process in the automobile shop develop constantly. The automobile owner who has purchased his car within the last year or so is anxious to have it brought right up to date with all the latest accessories and novelties of design. This desire for improvements has manifested itself in the increasing

**Fig. 1. Welding the Pocket and Sides.**

demand for wedge-shaped fenders which make it possible to carry a spare tire on the side of the car in a well in the front fender. This alteration can be made by any auto repair shop with the tools and oxy-acetylene equipment they already possess.

The tire-wells come ready made for small cars. In ordering wells from the manufacturer, the auto shop should take care to specify the make and model of car on which the alteration is contemplated so that the right size well

will be furnished. In the larger makes of cars, the pocket or rounded bottom of the well may be obtained for any size tire, and fitting it for a well is a simple matter. When only the pocket is obtained, the sides of the well must be cut from sheet metal according to templets for the different types of cars. These sides should then be welded to the pocket. Figure 1 shows this being done in a large automobile shop, and Figure 2 shows the completed weld. A well of any size or depth may thus be made.

It is unnecessary to remove a fender to install a well nor

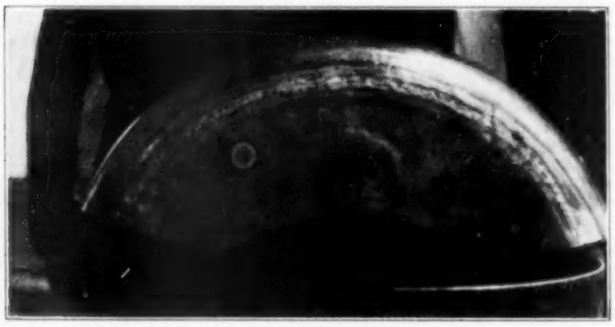


**Fig. 2. The Well Ready For Installation.**

is there any reason why the fender finish should be marred. In locating the well, careful measurements should be made to make sure that the tire will not interfere with the opening and closing of the front door and also that the bottom of the well will neither come near the front wheel nor come below the level of the running board. In order to avoid spoiling the well, a templet should be made on the reverse side of the fender at the point where the well is to be welded on and the well trimmed to this templet. This section of the fender should be cut out as shown in Figure 3,

**Fig. 3. Hole Cut in Fender.**

leaving a margin of three quarters of an inch of the metal on each side of the hole which will therefore be smaller than the dimensions of the top of the well. The extra three quarters of an inch of metal around the hole should be flanged down so that the flange just fits inside of the well. Small vee notches may be required at several points on the flange. The heat of an oxy-acetylene flame will facilitate the bending of the flange.

When the well and the fender have been fitted, a neat weld can be made with the sheet metal welding blowpipe. The weld may be ground afterward and a coat of lacquer applied to the job in the same color as the fender, so that it will be difficult to detect the weld from the base metal itself.

As a final operation a small hole should be made at the lowest point in the well to allow proper drainage as a small amount of water kept there would eventually rot the tread of the tire. After the first well is made and fitted, a templet should be kept, showing the correct proportions for a similar car and tire. As a finishing touch, an aluminum band may be placed around the top of the well as shown in Fig. 4, which serves not only to conceal the joining of the fender and well, but also adds to the attractiveness of the installation.

Every up-to-date auto repair shop today has an oxy-acetylene welding and cutting unit, and the above application is only one of the numerous new opportunities for the use of the process which occur every day in that field. The number of new automotive fittings developed every year should create an unlimited field for the process. — *Oxy-Acetylene Tips.*

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## A PROBLEM SOLVED IN SEWER CONSTRUCTION

**By E. B. Heyer***

In a recent issue of *The Welding Engineer* I outlined the problem of opening an old sewer, while flowing full, at the spot it crossed a new sewer.

We have since been called upon to give our advice and help in making another connection, but under different conditions, and in another way. Instead of breaking open a cast iron pipe that was enclosed in a large cement box, we had the problem of carrying the sewage flow through an excavation in which the cement box had yet to be built. In the job previously mentioned it was possible to dig under the old C. I. sewer pipe and lay the cement before breaking into the flow. But now we had a sewer that was 30 years old, 30 inches inside diameter and constructed of brick in the shape of a pipe. It would be impossible to dig under this as it would collapse, allowing the flow to fill the excavation. After studying the problem we decided the only way would be to make a pipe that would fit the inside of the brick sewer, which had been broken open on top. This would be lowered into place, sealed on the upstream end and suspended there while the old brick sewer was broken out. The cement box could then be built around the pipe, and when finished the pipe would be removed. In that way the 2 sewers would be connected, as were the other two we wrote of recently.

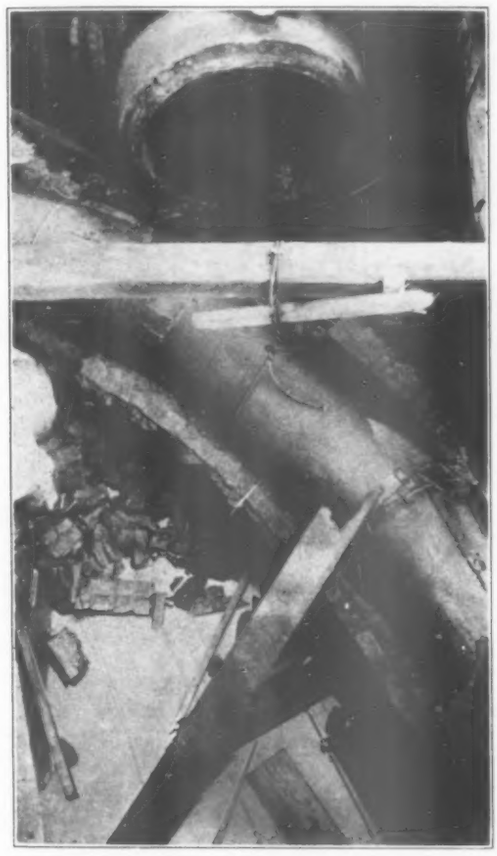
The part of the job where we came in was in making the pipe to fit the brick sewer, which made a near right angle turn at that spot. We hunted around and soon found some old 28 inch welded pipe which would do the job. This was taken up to our shop and at 6 p. m. Saturday evening we began work on it.

We first cut 3 lengths, 6 ft. long, only to find that one of the pipes we had cut was smaller in diameter than the other two. The only answer to this was to use the small piece in the center, and slip the end pipes over this. Even then it was necessary to split the large pipes and hammer down the split edges to meet the smaller pipe. The three sections met at a slight angle in order to form the curve necessary, and after this was lined up, we electrically welded both end sections to the center one, making a rather patchy job, but a sturdy and serviceable one. The time required to make this was about 14 hours. By working until midnight Saturday, from 6 a. m. to 12 noon Sunday, and from 6 a. m. to 8 a. m. Monday it was possible to have the pipe ready at the promised time. We had purposely made this pipe a little long and

*A. P. Heyer Welding Works.

went on the job with a cutting torch in case it needed shortening. The first time the pipe was lowered we found that the old brick sewer was egg shaped, and would not take our pipe. To shape the pipe we made a runway of planks from the ground up to the pipe, then ran a steam shovel up this. When the pipe was the proper shape the shovel backed off. The next time is was lowered we found it too long and had to trim some off. We lowered it again and after a little more trimming, it slid into place and was ready to be sealed.

Under the conditions it was about the only way the job



**View Straight Down at the Sewer Repaired.**

could have been done in such quick time, and when a steam shovel, two trucks and a gang of laborers are waiting to go to work, there is no thought of expense and no time to lose. The sewer had to be finished at a specified time and understanding such conditions in modern business we have worked out a system by which such service as is mentioned in the foregoing article, can be given at almost any time. Our part of the job cost our customer just $75.00 and was done by one man.

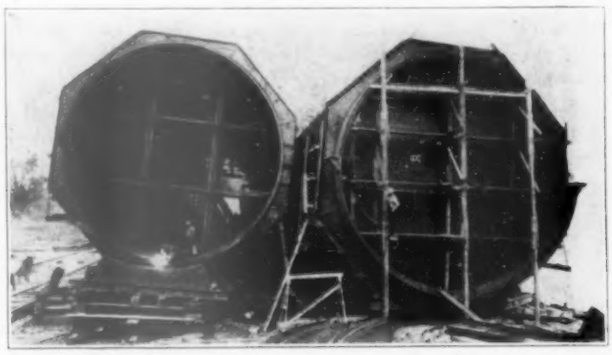
## LAUNCHING A TUNNEL LIKE A SHIP

The new vehicular tunnel which will run under the Detroit River between Detroit and Windsor, Canada, is being constructed on dry land in sections that are launched, floated into position and sunk to their places on the bottom of the river. The work is being carried on by the Canadian Bridge Company at Ojibway, Canada, six miles down the river from the tunnel site.

Each 250-foot section of the tunnel, with an inside diameter of 31 feet and an outside diameter of 35 feet, is constructed on regular launching ways, much as is a steel ship. The sections are built up of 24-foot strips of steel plate electrically welded together with General Electric welding machines. Approximately one and three-quarters tons of welding electrode are required for the 5200 feet of caulk welding around the full circumference of the shell in 42 places, and for the 1100 feet of butt welding.

After all the joints are tested for possible leaks, bulkheads are placed at either end, and the huge 450-ton tube is launched. It is towed to the dock of the Canadian Steel Corporation at Ojibway, where some 4200 cubic yards of concrete are poured in to form the lining and outside covering. Now weighing approximately 8000 tons, the shell is towed up the river to the tunnel site and sunk into the ditch in the river bed that has been dredged out for it.

On August 1, four of the sections had been set in place, and it is expected that most of the remaining sections will be in place before cold weather comes.



**Welders Working on Sections of the Arc Welded Detroit Vehicular Tunnel.**

The approaches are being bored by the largest shield ever used in North America. The tunnel from the corner of Randolph and Atwater Streets in Detroit to the river edge, 466 feet in length, was completed early this summer and the shield was transferred to the Windsor side where it is now working on the 986-foot approach to the river from that side.

This giant shield, 35 feet in diameter and 15 feet long resembles a curious overgrown burrowing animal. Its teeth and claws are the 110 men called muckers working in three shifts, whose task it is to dig away the dirt from in front of the shield with small power shovels. After the dirt has

**Side View of a Section of the Detroit Vehicular Tunnel.**

been removed, the shield is driven forward, 30 inches at a time, by hydraulic jacks that are capable of exerting a pressure of 150 tons. To make the resemblance to an animal more striking, a long tail projects from the posterior end of the shield. This tail prevents the roof of the tunnel from caving in until the steel lining and concrete inner lining is in place. Concreting begins as soon as the shield has moved far enough to allow room for the 25-foot form.

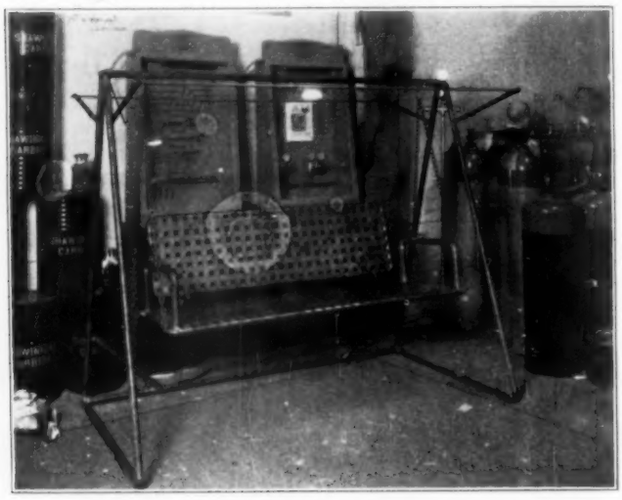
The completed tunnel will be almost three-quarters of a mile long, approximately one-half a mile of which will be under the river. The roadway will be 22 feet wide and will allow a clearance of more than 14 feet overhead. The width of the roadway will permit the operation of two lanes of traffic continuously with ample space left for a third lane in case of an accident or fire.

The use of steel, which made this form of construction possible, was in turn made possible by arc welding. With arc welding it was possible to make watertight seams.

## REGO DEMONSTRATES MANY PRODUCTS IN PRIZE CONTEST

An attractive welded lawn swing was given as a prize by The Bastian Blessing Company in the recent meeting of the National Metal Exposition Show at Cleveland, and the winner of the raffle contest was Mrs. Paul Orr of Wilkinsburg, Pennsylvania.

This swing was built to demonstrate the possibilities of pipe and tubing welding and the use of tube turns, furnished by The Tube Turns Company Company of Louisville, Kentucky. This work was done at Booth No. 239, which was jointly occupied by The Bastian Blessing Company, Shawinigan Products Company, and Gas Products Company.



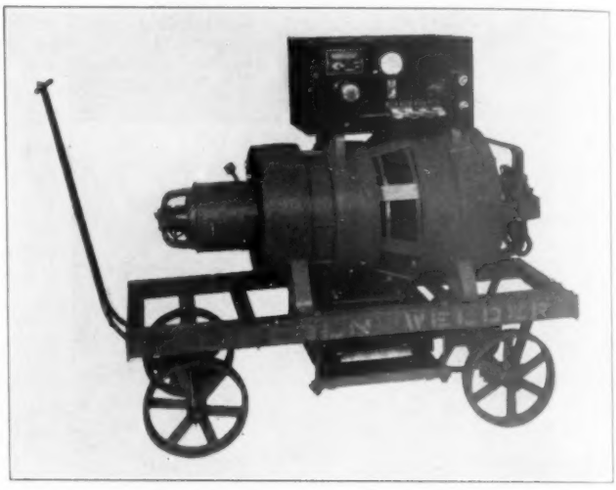
**Swing Built of Pipe and Tube Turns by Welding.**

The exhibit was very attractively arranged to display Rego welding equipment and high pressure manifold valves and fittings. The gas used was of the Read Head Brand furnished by the Gas Products Company of Cleveland, and the Shawinigan Products Company had an attractive display of carbide products.

The Bastian Blessing Company demonstrated several new developments in the welding field. Among these developments were the new Rego Thomas torch, especially constructed for pipe welding. A new complete unit for production welding was displayed. This consisted of double stage regulators for both gases and an automatic gas shutoff valve with a pilot light and a light welding torch in which the usual needle valve control was entirely eliminated. This particular outfit is said to be very popular in the automotive industry. One of the most recent developments of the Bastian Blessing Company is the new airplane torch especially designed for fusilage welding. The principal feature claimed for this torch is the great ease with which the flame size can be varied from maximum to minimum with one motion of the thumb.

## LINCOLN BULLETIN DESCRIBES NEW STABLE-ARC WELDER

The Lincoln Electric Company, of Cleveland, Ohio, has recently issued a new bulletin dealing with their latest type of Stable-Arc Welder. This machine was on exhibit at both the National Metals Exposition at Cleveland, and the National Petroleum Exposition at Tulsa. One of the features of this machine is that the generator frame, as well as the pole pieces, is entirely laminated. This feature of construction reduces the magnetic reluctance to a minimum and results in practically no delay to flux changes with respect to voltage changes in the arc. This means as voltage changes take place in the arc, the machine voltage also changes instantly,



**The New Lincoln Stable Arc Welder.**

with no lag, and the result is a stable arc over the entire wide welding range of the machine. Also, a separately excited generator field maintains a constant field excitation in the welder, under all load conditions, even to a short circuit. Thus the field has the necessary current immediately after the arc is interrupted to re-establish the arc. Another feature is that it has the dual control, with which the operators can vary open circuit voltage and welding current entirely independently of each other. This permits the use of stationary commutator brushes at the exact neutral point, insuring good commutation throughout the entire welding range.

## NEW STEEL WORK BENCH OF INTEREST TO WELDERS

The new Hallowell-Westric steel work bench recently put on the market should be of use to those engaged in various types of welding. It is of all-steel construction, made by the Standard Pressed Steel Company, Jenkintown, Pa., after the fashion of the steel shop equipment manufactured by them. The top is one solid piece made of a non-burning hard compound called Westric. This compound was developed by the Western Electric Company for use in their shops. It has several interesting characteristics in that it resembles marble, but is not cold to the touch, deadens sound, and can be hammered and pounded without cracking. The qualities claimed for it seem to suggest it as an all-around working surface for factories. The Standard Pressed Steel Company makes an extensive line of steel shop benches which are particularly recommended for welding schools and shops where production welding is done.

## CROWN PRODUCTS CO. EXPANDING

Crown Products Co., 885 East 134th St., New York City, (formerly Crown Chemical Co.), due to increased demand, have expanded facilities for production and sale of their products, Crown Radiator Fix and Crown Boiler Fix.

Crown Radiator Fix is widely used in making welds on cast iron watertight. It is claimed that porous welds due to expansion cracks after weld is completed, no longer present a troublesome problem, through use of this material. Crown Radiator Fix repairs cracked and leaky water jackets, motor heads, water pumps, leaky radiators, and, in fact, the water system in its entirety. Crown Radiator Fix contains nine ingredients, including crushed aluminum. When the compound is applied, the aluminum plates itself over and over, and in a few minutes a metal patch is formed. Crown Boiler Fix, used by the plumbing trade for repairing cracked boiler sections, finds successful use in welding shops engaging in boiler repair. The Crown Products Co. is affiliated with the Crown Aluminum Solder Co., makers for the past fifteen years of welding specialties. The latter company is sole distributor to the welding trade.

## FLANGES FOR WELDING

Drop forged tank and boiler flanges already prepared for welding to tanks, barrels and boilers offer many advantages in the production of such receptacles. A complete line of such flanges is made by the Bonney Forge and Tool Works, Allentown, Pa. These flanges are drop forged of special welding steel and carefully threaded to standard gauges. They can be supplied in either straight or taper pipe threads for welding on light tanks, standard drums and barrels. A considerable number of standard sizes for ordinary requirements are either carried in stock or available at short notice and as manufactured comply with the specifications of the underwriters. Lists of these standard welding flanges can be had on application and the company is prepared to make up special flanges when required.

## THE HANSEN ARC TORCH

One of the new welding processes demonstrated at the National Metal Exposition in Cleveland last month was the Hansen Arc Torch. The demonstration showed that this new tool has operating characteristics different from other welding processes now in common use and consequently it attracted a great deal of attention and visitors were keenly interested to learn some of the possibilities of the process. The arc torch has been in course of development for several years and is an adaptation of the principles of the double carbon electrode arc welding process, which when first introduced was known as the electric torch. In this process, the current does not flow through the metal which is being welded but instead an arc is struck between two carbon pencils, and the heat of the arc used to secure fusion is used in somewhat the same manner that the heat of the gas flame is used for the same purpose.

Sometime ago, Mr. K. L. Hansen, who is associated with the Northwestern Manufacturing Company, Milwaukee, Wisconsin, developed a special type of electrode holder in which two positive carbons and one negative carbon were used. Some improvements over the use of two carbons were noted but experimental work indicated that more satisfactory results were obtained by substituting for the two positive carbons, a single large carbon with a narrow section in the center, producing the effect of a double bodied electrode. In the center of this large electrode, that is, in the narrow section, there is inserted an aluminum core. The effect of the aluminum core is to produce a quiet, steadier, and more concentrated flame which is much easier to handle. It also acts as a di-oxidizer which is very beneficial especially when welding ferrous metals. Experiments with copper alloy rods have shown very promising results, especially those which are higher in zinc. Excellent welds have also been obtained in aluminum. The apparatus for this work will be marketed by the Northwestern Manufacturing Company under the name of the Hansen Arc Torch.

## SIX-CYLINDER GAS ENGINE DRIVES NEW PORTABLE ARC WELDER

A new portable electric arc welding machine announced by the General Electric Company is driven by a 6-cylinder gas engine, and replaces the 4-cylinder engine-driven unit previously included in that company's line. Advantages of the 6-cylinder engine are ease of starting, steadiness of operation and greater capacity. The generator bears the designation WD-300-A.

The new engine is the Buda model HS-6 power unit built especially for industrial service. The cylinder head is a four-cycle, L-type. The bore is 3⅜ inches and the stroke, 4½ inches. The S. A. E. horsepower rating is 27.3 and the actual brake horsepower is 39 at 1440 r. p. m. The engine is totally enclosed in a sheet-metal housing. Gasoline consumption averages 2.4 gallons an hour for average welding duty at full normal-rated load.

The engine is equipped with a radiator of strong construction, centrifugal water pump, United centrifugal-type air cleaner, Eiseman high-tension magneto with impulse starter coupling, gravity-fed Zenith carburetor with choke control, speed-regulating governor, gas tank of ten gallons capacity, starting crank, oil gauge and oil-pressure gauge.

The welding generator is a ball-bearing, self-excited, single-operator machine rated 300 amperes, 1 hour, 50 deg. C. with a current range of 90 to 375 amperes in accordance with N. E. M. A. standards. Included with the set is a current-reducing resistor by means of which welding currents down to 25 amperes may be obtained. The current can be adjusted simply by turning the brush-shifting handle. When operating so that the potential at the generator panel, including reactor drop, is 25 volts, any value of current can be obtained between 25 and 400 amperes.

A 500-ampere ammeter and a 120-volt voltmeter are mounted on the generator panel. A self-adjusting stabilizing reactor automatically steadies the arc. The automatic regulation is obtained by specially designed magnetic circuit without any moving parts.

The complete outfit is mounted on a welded structural-steel base and may be made portable by the addition of running gear. Where used for outside work, a canopy can be provided to protect the generator from the weather.

The set is approximately 88 inches long, 32 inches wide and 69 inches high, the last dimension including 18 inches for the running gear. The net weight without running gear is approximately 3300 pounds and the shipping weight is 3750 pounds. The net and shipping weight of the running gear is 180 pounds; the canopy is 140 pounds, net, and 185 pounds shipping weight, net.

## PREST-O-WELD TWO-STAGE OXYGEN REGULATOR

The Oxweld Acetylene Company, 30 East 42nd Street, New York City, has added to the Prest-O-Weld line a two-stage oxygen regulator, designed to eliminate fluctuation in working oxygen pressures. This regulator, which is designated the type R-109, incorporates the stem-type valves, which have proved extremely satisfactory in single-stage regulators.

The chief feature of the improved design is two-stage pressure reduction, accomplished through the medium of two independent sets of diaphragms, valves and springs. Instead of reducing the full cylinder pressure of about 2000 lb. per sq. in. down to working pressure, which is often only a few lb. per sq. in., in one-stage, the R-109 regulator reduces through this wide range in two stages. In the first stage the cylinder pressure is reduced through a non-adjustable reduc-

ing valve to about 175 lb. per sq. in. Leaving the first stage the oxygen passes to a second valve and diaphragm assembly, where the pressure is reduced to that desired by the operator, the second-stage reducing valve being adjustable by means of the hand wheel. Thus, instead of reducing the full cylinder pressure to working pressure, the second stage is required to regulate pressures within only a narrow range, which it can do easily and efficiently.

When the pressure in the cylinder falls below about 175 lb. per sq. in., the first-stage valve remains fully open. It is thus automatically cut out of the system and the second-stage valve and diaphragm only are operative. The type R-109 regulator will operate with equal efficiency whether the oxygen cylinder is full or nearly empty, and the working pressure will remain constant.

Trouble sometimes experienced in the past from opening cylinder valves with the adjusting screw of the oxygen-regulator turned in, thus permitting the full cylinder pressure to enter the low-pressure gauge and rupture the Bourdon tube or damage the valve stem of seat, has been largely eliminated in this regulator since it is impossible for the full cylinder pressure to enter the low-pressure gauge. The first-stage valve is of such sturdy design that it will withstand the most severe impact likely to occur.

The type R-109 oxygen regulator supersedes the type R-105. It is provided with 3000-lb. and 10-lb. gauges, and is equipped with a ¼-in. ferrule hose connection.

## SPARTAN METALS FOR HARD FACING

A new bulletin of the Spartan Steel Company, Compton, Califorina, describes Tungspar, a hard facing metal for which there is claimed an unusual degree of toughness. This metal can be applied by either oxy-acetylene or electric arc welding. It comes in rod form packed in 25 and 50 lb. boxes. Information is also given on Spartan Duridium diamond inserts. This diamond substitute is available in several sizes and is recommended to be fused on to the abrasion surfaces. It is packed in 1 lb. boxes and also supplied in tube form is a seamless steel tube containing 4 ounces of Duridium chips. The bulletin gives complete detailed instructions for applying both of these metals.

## WELDING WITH AUTOMATIC HYDROGEN FLAME

An article by Mr. R. A. Winman of the Research Laboratory of the General Electric Company, published in the October issue of the General Electric Review, contains a considerable amount of up-to-date information on the welding of ferrous and non-ferrous metals by the Automatic Hydrogen Flame. Information and suggestions are given for welding tungsten, molybdenum, cast iron, alloy steel, aluminum, aluminum alloys, brass and nickel.

## NEW HARD FACING ROD TO BE MANUFACTURED

There will soon be put on the market a new welding rod for hard surfacing, which is the result of experimental work on the part of Thos. D. Ketchbaw of Chicago and R. L. Scollard of Phoenix, Ariz., during the past several years. It is used as an electrode in arc welding (either metallic or carbon arc) flows very smoothly and freely, fusing with any clean metallic surface. Grain structure closely resembles the higher grades of tool steel.

Brinell hardness is 772. Scleroscope test 70-80 (ten specimens). When used as a machine tool exceptional durability is claimed, as it has stood up under hours of continuous service on chill castings. A corporation is now in the process of formation for the purpose of producing the rod on a large scale.

## CATALOG OF NATIONAL PRODUCTS

National Tool and Metals Company, Torrance, California, have recently issued general catalog No. 29A, listing their line of hard facing materials, oil field specialties, welding rod and equipment. Drillite is described as a diamond substitute in paste form so prepared that it may be applied to welding surfaces by either oxy-acetylene or electric arc welding. Anglite is made for similar purposes and is put up in six different forms, including the tube form. Eldmetal is a new hard facing metal supplied in rod form, which can be applied with either the oxy-acetylene or electric arc welding. The catalog lists also a number of different types of welding rods, including high carbon, mild steel, nickel steel, cast iron and Tobin Bronze. The company carries a complete line of welding accessories for both gas and arc welders.

## NEW GIBB BARREL WELDING EQUIPMENT

What promises to be an interesting new development in the manufacture of welded steel barrels is a combination resistance welding process exhibited by the Gibb Welding Machine Company, Bay City, Michigan at the National Metals Exposition in Cleveland. The entire procedure, is designated briefly as the Gibseaming Process, but as demonstrated at the Cleveland show it involves the use of two of the resistance processses, namely spot welding and seam welding. Two machines are therefore required. One of these is the new Gibb Multiple Head Spot Welder. This spot welder has a throat deep enough to accommodate six spot welding electrodes. These are operated by six cams mounted on a single shaft. The shell of the barrel is inserted in the machine in such a way that the spot welding points are all held over the line of seam. When the machine is operated the six spot welds are made in rapid succession and serve the purpose of tacking the shell in place for the welding operation on the same welding machine. Since the welds are not made all at the same time only a single transformer is required and each weld receives the full benefit of the secondary or welding current. The seam welding machine is a new model of the Gibseamer. A feature of this machine is the knurl drive. The welding operation is accomplished by running the seam between two roller electrodes. These are driven by knurled wheels which clear the contact surface of the welding seams continuously. There is also a trimming device to trim the edges automatically, the total effect being to maintain a uniform contact surface at all times.

The manufacturers state that in actual operation it has been found that one set of rolls will weld 25,000 barrels without any attention. The production capacity of the entire equipment is given from one hundred to one hundred and twenty barrels per hour. The process requires the use of two men for grinding, two men for spotting and one man for seaming. Some of these jobs can be coupled up with present labor, such as rolling and handling. The Gibb Welding Machine Company has prepared an attractive booklet describing the operation in detail and illustrating the machinery used.

## NEW TENSILE TESTING MACHINE

The Linde Air Products Company of New York occupied booths 18-19 and 20 in the Texas Building at the International Petroleum Exposition held at Tulsa, Oklahoma, October 5th to the 12th inclusive. A feature of the Linde Exhibit was a daily contest in which every visitor at the Linde booth was given an opportunity to estimate the tensile strength of welded coupons made with Oxweld No. 1 High Test Rod. Five of these coupons were welded each day and used in the contest which was open to the public. Each evening these coupons were pulled on a tensile testing machine, and the person guessing nearest to the actual strength of the welds received a prize.

The tensile testing machine used is a recent development of the Union Carbide and Carbon Research Laboratories, Inc., Long Island City. It is a unique machine in many respects. It weighs less than 200 lbs. and is consequently portable. It is possible to carry it into the fields and to test a welder's ability "right on the job." Readings can be taken directly from the gauge. It has a capacity of 10,000 lbs.

## ELKONITE POINTS IMPROVE ETCHING MACHINE

A folder recently published by Wm. Brewster Company, Inc., 50 Church St., New York City, indicates an interesting new use for Elkonite, a copper tungsten alloy which has become very popular for electrode tips and clamping dies for resistance welding machines. The Brewster Company manufactures the etchograph which is an electrically operated device for etching all kinds of metals. The work is done with a small instrument built exactly like a pencil and handled like a pencil; that is, the operator writes whatever he desires directly on the metal. The pencil point formerly was made of copper but the copper points have recently been replaced by points made of Elkonite which is much more durable and is said to give deeper and clearer markings. The etchograph, incidentally is an excellent device for making welded assemblies, particularly test specimens because all desired data can be marked on each specimen in practically the same time it would take to write them on a piece of paper.

## RARE METALS DESCRIBED IN FANSTEEL BOOKLET

A booklet received from the Fansteel Products Co., of North Chicago, Illinois, is entitled "Rare Metals" and takes up the history, properties, and uses of three rare metals: tantalum, tungsten, and molybdenum. The average person is familiar with some of the uses of these metals, but in general not much is known of the chemical history and properties of the metals. This booklet takes up each one of these metals separately and discusses it from beginning to end, or from the ore to the finished products. The book is easy to read and well illustrated, and undoubtedly if one would familiarize himself with the properties of these metals as described here he might find that they could be of economic use in other ways than those already mentioned. For example Tantalum welds easily to itself and several other metals, particularly nickel. That fact alone suggests a great number of possibilities for its use. As it is unaffected by acids, alkalies, and gases one can see that it might be of use in a great variety of places. This booklet contains some fifty-four pages, the last fifteen of which are devoted to tables of facts and figures on rare metals.

## WELDING TESTS DESCRIBED IN AWP BOOKLET

Alloy Welding Processes of Walthamstow, England, have recently written an interesting bulletin, No. 61, entitled "Conclusive Welding Tests." It deals in particular with the metallic arc welding of defective castings in the foundry. The bulletin suggests that welding has been in ill repute in the foundry business particularly because of some of the poor quality welds with which they have had experience. The bulletin goes on to say that foundry-men can increase the quality of their welded castings by first obtaining the best materials for their particular purpose, and then training, supervising, and constantly testing their operators.

The bulletin contains descriptions and data sheets regarding tests made on a number of welded steel castings. The tests were made in co-operation with the Edgar Allen & Co., Ltd., of Sheffield, England, and as a demonstration in the presence of Mr. Gough, the Admiralty Overseer of Castings. Very conclusive shock and bend tests were made and the conclusions reached were that heavily coated electrodes were giving best results on steel castings. The data sheets in the bulletin covering the tests contain information regarding sizes of specimens, stress, yield point, elongation, etc., all of which should prove of interest to the welder of steel castings.

## NEW ALTERNARC LITERATRUE

The Electric Arc Welding and Cutting Company, Newark, N. J., has recently issued several new bulletins covering their line of A C and D C Arc Welding Equipment. One of the bulletins is devoted entirely to the description of the Dualarc welder which delivers both D C and A C current. Another is devoted entirely to the Alternarc line of A C Arc Welders. A third bulletin describes the purpose of flux coatings on electric welding wire and includes a complete price list of the Newarc line of flux coated electrodes.

## LINCOLN PUBLICITY FEATURES PIPE LINE WELDING

The Lincoln Electric Company, Cleveland, Ohio, has recently published two bulletins on the subject of electric welding of pipe lines. One of these is a description of a particular line for the Texas Pipe Line Company in the Panhandle district. The other tells how the process has been used or is being used in the construction of pipe lines totaling more than 3000 miles. The second bulletin gives considerable operating data as well as inspection and test methods.

## NEW FUZON BULLETIN ANNOUNCES TYPE-T WELDING ROD

Bulletin No. 3 of the Fusion Welding Corporation is devoted to describing a new alloy steel recently developed by them and entitled "Weldite Type-T Welding Rod." The bulletin gives full particulars regarding the possible uses and the application of this metal. First, a general description of the alloy is given touching upon the chemical and physical characteristics of the metal. Then with this in mind it proceeds to take up the operating technique on various kinds of work. The metal can be used for depositing a cutting edge for a metal cutting tool, or it may be applied to a digger tooth, or spread over the surface of a fairly large body, as in the case of a stamping die. In applying this alloy with the oxy-acetylene torch, the Type T-G rod is used. In describing this application the bulletin contains some very interesting photos and drawings showing the results of using the carbonizing, neutral, and oxidizing flames. Also a table of tip sizes and rod sizes for various thicknesses of metal to be laid on is contained in the bulletin. In depositing it with the metallic arc the Type T-E rod is suggested for use, and the bulletin gives the proper current values for the different thicknesses of rod. It is claimed that Type T-G metal properly applied will give a Brinell hardness of approximately 600. The bulletin lists about eighteen different industries in which this metal might be useful.

## ARMCO INGOT IRON IN THE OIL INDUSTRY

"How Armco Ingot Iron Saves in the Oil Industry" is the title of a recent booklet distributed by the American Rolling Mill Co. of Middletown, Ohio. It contains some thirty pages of well illustrated and interesting information regarding the uses of Armco iron in the oil fields and refining industries. Near the front of the book are some micro-photographs which show the structural differences between Armco ingot iron, mild steel, and wrought iron. Two of the following pages are devoted to describing the welding qualities of this metal which are claimed to be quiet satisfactory for all types of welding. More microphotographs show the effects of welding heat on various sections of welded Armco iron and mild steel. The remainder of the booklet takes up the physical properties of their metal, and its various uses in oil producing, refining, and marketing equipment. Quite a number of photographs are shown of Armco Iron in use by oil companies located in all parts of the world.

## NEW MAGAZINE ON WELDING

Notice has been received from the Institution of Welding Engineers, London, that they are planning to issue quarterly to the members, without charge, a new publication entitled "Welding News." It is proposed to publish in Welding News various extracts from the technical press of all countries, together with other articles relating to welding which may be considered of special interest to members of the Institution. Members have been invited to submit to the council articles or other detailed information regarding welding subjects, with a few to having them published in Welding News if they are considered suitable. Arrangements have been made with the Welding Journal, London, whereby the Institution is permitted to reproduce articles which have already appeared in that magazine and which the council considers to be of such value to the members as to be worthy of re-publication. The first issue of Welding News bears the date line of October, 1929. It contains articles on bronze welding cylinder blocks, arc welding cast iron, testing welds for soundness, welding duraluminum and sheet metal welding, together with brief abstracts of a number of articles appearing in the technical press of Europe and the United States.

## NEW HANDBOOK ON ARC WELDING

Alloy Welding Processes, Ltd., London, England, have recently published a new operator's handbook for electric arc welders. This is prepared for free distribution to their customers and friends in the welding industry. The book starts with a very well prepared set of welding instructions for beginners, then follows a description of the A. W. P. process, which involves the use of a special coated electrode material. Various types of electrodes for different classes of work are described, after the theory of their method of coating has been explained. There are also included tables of data on current values, electrode consumption, rate of welding, etc., for various types of joint in different thicknesses of material. The book concludes with illustrations of various A. W. P. machines and a number of interesting welding operations.

## AN ELECTRIC AND GAS WELDING WIRE CHART

Quite an attractive welding chart has been prepared suggesting the proper welding wire to use on a great variety of jobs for both gas and electric welding. In each case there is a description of the physical characteristics of the wire, the types of work it is best used on, and the number of amperes to use with various sizes. In the field of gas welding a number of steel alloy rods, cast iron, bronze, brass, and aluminum rods are described. Around the margins of the chart are several valuable tables giving melting points of metals, diameters of wire for various thickness of work, approximate tensile strength of metals, and other miscellaneous data. Also a number of hints are given for handling special kinds of jobs. Many welders are acquainted with the first edition of this chart, and this new revised edition should be of interest to every welder. It is issued by Williams & Company, 901 Pennsylvania Ave., Pittsburgh, Pa.

## DEALER WANTS MORE LINES

Mr. Roy Thomas, proprietor of the Torch Shop, 1617 E. Vernon St., Los Angeles, California is doing a thriving business in oxy-acetylene welding and cutting equipment and welding supplies of all kinds. Mr. Thomas had a very wide experience in the repair of different kinds of apparatus, and conducts an unusually large repair department. A recent letter from him indicates that he is on the lookout for agencies for articles used in connection with welding and will be glad to receive literature from manufacturers who are looking for good representation in a Los Angeles district.

## NEW QUASI-ARC LITERATURE

Quasi-Arc Incorporated, 11 W. 42nd St., New York City, recently published a series of bulletins regarding the Quasi-Arc Welding System. One of these describes the character of these electrodes and lists the advantages which are claimed for them. The second includes a description of corrosive action on welds and describes some interesting corrosion tests. The third is a set of instructions for operators who use these electrodes. These instructions include the proper preparation of the joint and the proper welding procedure for a number of different types of work.

# News of the Industry

A full day class in the Cleveland Welding School devoted Tuesday, September 24, to an inspection trip in the plant of the Gas Products Company of Cleveland. Mr. Steven M. Mills, superintendent, took the body in charge and showed the method of charging generators, following this up by showing the method of attaching cylinders to the line after the proper amount of acetone had been added to the cylinder, showed them the method of determining by weight the amount of gas contained in each cylinder at the end of charging, and then took them to the loading and shipping departments.

This particular trip is one of the regular monthly inspection trips that the Cleveland Welding School will stage during the winter season.

The Gunite Corporation of Rockford, Illinois, announces the appointment of Erwin J. Mohr as Manager of Industrial Sales. Mr. Mohr has had many years' experience in such sales work as he will conduct for the Gunite Corporation, i.e., working with machinery manufacturers to solve problems and save costs through the use of special ferrous metals. Mr. Mohr is widely known in the field, having served for many years as sales manager for the Kinite Corporation of Milwaukee, Wis.

R. D. Thomas and Company of Philadelphia and New York announce that they are now distributors for the new Arcos Electrodes. These electrodes have been developed in Belgium and are extensively and favorably known throughout Europe, but have only recently been introduced in this country. A description of these electrodes was given in The Welding Engineer last month.

Mr. M. E. Danford, for more than seven years Works Manager of the Middletown Division of The American Rolling Mill Company, has been appointed Assistant Vice-President of that company, according to an announcement issued October 4th by Mr. Charles R. Hook, Vice-President and General Manager.

Compressed Industrial Gases, Inc., announce the following organization changes effective October 1st:

W. J. Lacey has been appointed manager of apparatus and supply department, with headquarters at 19 N. Sheldon St., Chicago, Ill.

R. E. Morgan has been appointed district manager of The Burdett Oxygen Co. (Oklahoma), with headquarters at 510 N. Hudson St., Oklahoma City, Okla.

R. J. Bailey has been appointed district manager of Burdett Oxygen & Hydrogen Co. (Pittsburgh), with headquarters at 40th St. and A. V. Ry., Pittsburgh, Pa.

William D. Seymour Company, Inc., 614 South Peters Street, New Orleans, a dealer in welding supplies, has been elected a member of the Gas Products Association.

The Modern Engineering Company exhibited Film number three, a motion picture of pipe welding, prepared by the Gas Products Association, at St. Louis, during the latter part of September.

Mr. D. J. Will, vice-president of the Stuart Oxygen Company, San Francisco, distributors of Rego Apparatus, was a visitor at The Bastian-Blessing factory the latter part of September.

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Removal of the Chicago offices of the American Chain Company, Inc., and Associate Companies, on September 28, to new quarters on the seventeenth floor of the Chicago Daily News Building, Room 1765, has been announced. This move on the part of the American Chain Company further centralizes the Chicago offices of several of the companies associated with it. The Associate Companies affected include Ford Chain Block Company, Highland Iron and Steel Company, The Manley Manufacturing Company, Page Steel and Wire Company, Reading Steel Casting Company and Wright Manufacturing Company.

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W. A. Smith, proprietor of the Acme Welding Supply Company, 33-36 West 61st Place, Chicago, is a distributor of Meco Welding and Cutting Equipment, also rods and other welding supplies.

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E. B. Whitemore, president of the Whitemore Oxygen Company, Salt Lake City, Utah, oxygen and hydrogen producers and distributors of National Carbide and Meco Welding Apparatus, recently visited Chicago, Washington and New York.

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An article in the September, 1929, issue of the Journal of the American Water Works Association, by Lloyd T. Jones, consulting physicist, Berkeley, Calif., describes and illustrates the construction of a flange welded pipe line 500 feet long and 2 feet in diameter, at the Jackson Creek Spillway of the Mokelumne reservoir. The pipe was fabricated in 30 foot lengths. The flanges were ½-wide, and about four times the thickness of the steel of which the pipe was constructed. The principal claims made for this type of joint are (1) it eliminates residual welding stress and is applicable to pipe lines of even the largest diameters, and (2) it provides a semi-flexible joint to care for seasonal temperature stresses or accidental stresses that may be imposed on the pipe line.

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The name of the Victorian Institute of Welding Engineers has been changed to, "Australian Welding Institute." At a meeting of the Institute held September 19 the program featured a lecture on "Speed Welding with the Automatic Machine," by Messrs. A. Aird and A. Horn.

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Henry Booth and Jack Kelly of the Shawinigan Products Corporation, New York, were in Chicago for the week end, October 12th, following their visit to the International Petroleum Exposition at Tulsa.

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At the World Engineering Congress and World Power Conference in Tokyo H. G. Reist, engineer in charge of alternating current engineering department, General Electric Company, will read a paper on "Rolled Steel in the Construction of Electric Machines," and Frank P. McKibben, consulting engineer of the same company will read a paper on "Structural Steel Welding."

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Fred Squire, formerly in charge of sales in the Chicago District for the Alexander Milburn Co., is now representing the Chicago Grinding & Machinery Co., distributors of K-G welding and cutting apparatus.

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M. L. Goodrich, manager Oxygen Department of Swift & Company, Chicago, spent his vacation at Walworth, Wis., during the latter part of September.

Engineers of the Victorian Railway Construction branch, Australia, can be given credit for a considerable amount of pioneer work in the application of welding to bridges. In the construction of a new single track between Darling and Glenwaverly there are five welded bridges in course of construction. Each of the bridges consists of one through span and two or more deck spans.

The latest addition to the list of firms whose system of electric welding has been accepted and added to Lloyd's Register of Shipping is the Premier Electric Company, Ltd., of Abbey Wood, London.

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The Office Central De L' Acetylene Et De La Soudre Autogene, Paris, is preparing to publish a series of twelve posters printed on heavy paper so that they may be affixed to the walls of welding departments, schools, etc. These posters contain suggestions of a general nature, safety suggestions, information regarding the welding flame, preparation, execution of welds, expansion and contraction, defects in welds, testing welds and cutting.

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The American Rolling Mill Company has accomplished some remarkable results this year in its safety program. The men of the eastern works of the Middletown Division established what is believed to be a world safety record for a large steel plant. Up to 5:15 on the morning of September 11th it had gone 47 days and a total of 1,241,823 consecutive man hours without loss of time because of accident. The Armco Girls have been as enthusiastic as the men. On Labor Day their first-aid team won the Girls' Station Championship with 794 points out of a possible 800 at the Coal River District meet of W. Virginia and in a later meet increased this score to 796.

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"Metal Arc Welding in Germany," by Chief Naval Constructor Lottman, is the title of a treatise which is being published in serial form in Marine Engineering. The paper is edited by James W. Owens, director of welding at the Newport News Shipbuilding and Dry Dock Company, who is well known to the industry as the author of "Fundamentals of Welding," and winner of the Lincoln Prize Essay Contest. At the conclusion of the paper Mr. Owens will contribute an original discussion and a comparison of German and American welding practices.

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A handsome example of high grade welded construction on heavy plate is illustrated in current advertisements of the Blaw-Knox Company, showing their steam purifier, which is known as the Drum Type Tracyfier.

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It is reported that there is now under construction by Deschimag at Hamburg an electrically welded merchant ship of 11,000 tons for the North German Lloyd line. It is expected that the ship will be launched in three or four months. The Hamburg agency of Lloyds of London and German insurance companies generally have placed electrically welded ships in the highest registry.

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Arc welded construction is an important feature of the Cliff steel sectional boiler which is being manufactured by the Terre Haute Boiler Works Co., Terre Haute, Ind. These boilers are made of 5/16 inch steel, and on account of the sectional feature can be made into a wide range of sizes from standard units. All sections will pass through an ordinary door or window.

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Alexander F. Jenkins, President and Treasurer of the Alexander Milburn Company, Baltimore, Md., is sailing for England on Saturday, October 12th, on the S. S. Leviathan for an indefinite visit.

A new Prest-O-Lite acetylene gas plant, located at 575 Kirkland Street, Grand Rapids, Michigan, has just been placed in operation by the Prest-O-Lite Company, Inc., of New York City. The plant, located on a private siding of the Michigan Central Railroad, commenced actual operations on September 16. This latest addition to the growing chain of Prest-O-Lite acetylene gas plants is under the superintendency of Mr. George Rose, Jr. The District Superintendent is Mr. W. L. Potts whose headquarters are at the Cincinnati Linde Plant. Mr. S. P. Murphy is Division Superintendent, with headquarters at the Bowman Bldg., Third and Ross Sts., Pittsburgh, Pa.

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Col. O. E. Engler, president The Balbach Company, Omaha, Neb., after devoting two weeks in active service of The United States Army, decided that this, together with his activities as president of the Gas Products Association, was sufficient justification for a vacation and traveled to Colorado Springs.

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Mr. E. Avery Jordan, representing Smith Welding Equipment Corporation, will exhibit the Gas Products Association's motion picture film number three, which illustrates pipe welding, at Seattle, Washington, October 21st.

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A new Linde Oxygen plant located at 1628 Cascade Street, Erie, Pa., commenced operations August 21, 1929. Mr. J. J. McKeen is superintendent of this plant and Mr. R. S. Hamilton, whose headquarters are at the East Buffalo Linde plant, is District Superintendent.

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Arvid Wickstrom 611 Providence Bldg., Duluth, Minn., distributor of Stoody products and Hansen arc welders, was a visitor in Chicago early this month.

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Electric Arc Cutting & Welding Co., Newark, N. J., announce opening of a Southwestern sales office in the Allen Bldg., Dallas, Tex.

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At the recent annual meeting of the National Safety Council, held at the Stevens Hotel, Chicago, J. I. Banash, consulting engineer of the International Acetylene Association, was elected treasurer of the Council for the ensuing year.

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A base of pressed steel channel sections welded into a single unit and having the grates installed is a feature of the electric welded steel heating boilers made by Johnston Brothers, Inc., Ferrysburg, Mich., and described in their new bulletin No. H-200.

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T. McLean Jasper, director of research, A. O. Smith Corporation, Milwaukee, furnished to the Iron Age of Sept. 26, a discussion to the effect that today vessels can be made which will not fail other than in the steel of the plate, with one photograph representing the endurance limit of the steel in the weld and adjacent to the weld, that in the weld being decidedly higher, and another photograph of a vessel which has been in service 3½ years and was withdrawn and tested to failure. The vessel had corroded from a thickness of 2½ inches down to a thickness of 1.6 in the plate. Failure avoided the welds completely. The Smith engineers recently staged a train wreck to test the efficiency of a welded steel sphere, 72 inches inside diameter, of 1½ inch plate, designed by them for the transportation of helium gas. The car was completely wrecked but the sphere showed no sign of damage. The sphere was then subjected to further severe tests and broke into nine pieces after the application of pressure had increased its diameter 17 inches. In no place did the break follow the weld.

General Welding and Equipment Co., formerly located at 75 Brookline Ave., Boston, Mass., has moved to new quarters at 70 Landsdowne Street, thus tripling their facilities, which were being overcrowded due to the increased demand for welding and cutting apparatus and automatic cutting machines.

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The regular October meeting of the executive board of the Compressed Gas Manufacturers' Association was held in connection with the usual October luncheon on Thursday, October 17, at the Hotel Astor, New York.

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The work of installing 5,700 feet of 8-inch steel gas main across the Hudson River for Central Hudson Gas & Electric Corporation was started September 27 by the L. E. Myers Co. They are also building a 20-inch steel welded gas main between Cicero Avenue, Chicago, and Lyons, Illinois, the latter job being under the direction of Supt. K. W. Hansen.

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R. G. Richards, formerly connected with the Barnes Wire Fence Co., Detroit, has recently been appointed representative of the Weldit Acetylene Company, Detroit, in western Michigan.

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The great field of usefulness for Naylor Spiralweld Pipe, made by the Naylor Spiral Pipe Co., Chicago, for oil, gas and water lines, is beautifully illustrated in their recently published Bulletin 29-2.

# Classified Ads

**Help Wanted—75c per line, minimum 4 line**
**Jobs Wanted—4 lines free.**
**Other Ads—$1.00 per line, minimum 4 lines.**
**Counted 8 words to line. Add 6 words for keyed address.**

**Men Wanted**—Three experienced electric welders who have been working on men-of-war for several years and are able to make calculations, want position in America. Reply, stating salary, to H.N. 7503, Rudolf Mosse, Hamburg (Germany).

**Position Wanted**—As welder in charge of maintenance in large plant. Have had seventeen years of gas welding experience on a wide variety of production and job shop work. Some arc experience, and want more. Address 207, care The Welding Engineer.

**OXYGEN-HYDROGEN-ACETYLENE PLANT**

**For Sale**—Complete Electrolytic Oxygen and Hydrogen Plant made up of 115 type "B" ELECTROLAB cells. Capacity per 24 hours—13,248 cubic feet oxygen; 26,496 cubic feet hydrogen. Acetylene generator—3,000 cubic feet per hour capacity. Equipment includes compressors, high and low pressure tanks and all accessories. In first-class condition and can be seen in daily operation. Address 204, care The Welding Engineer.

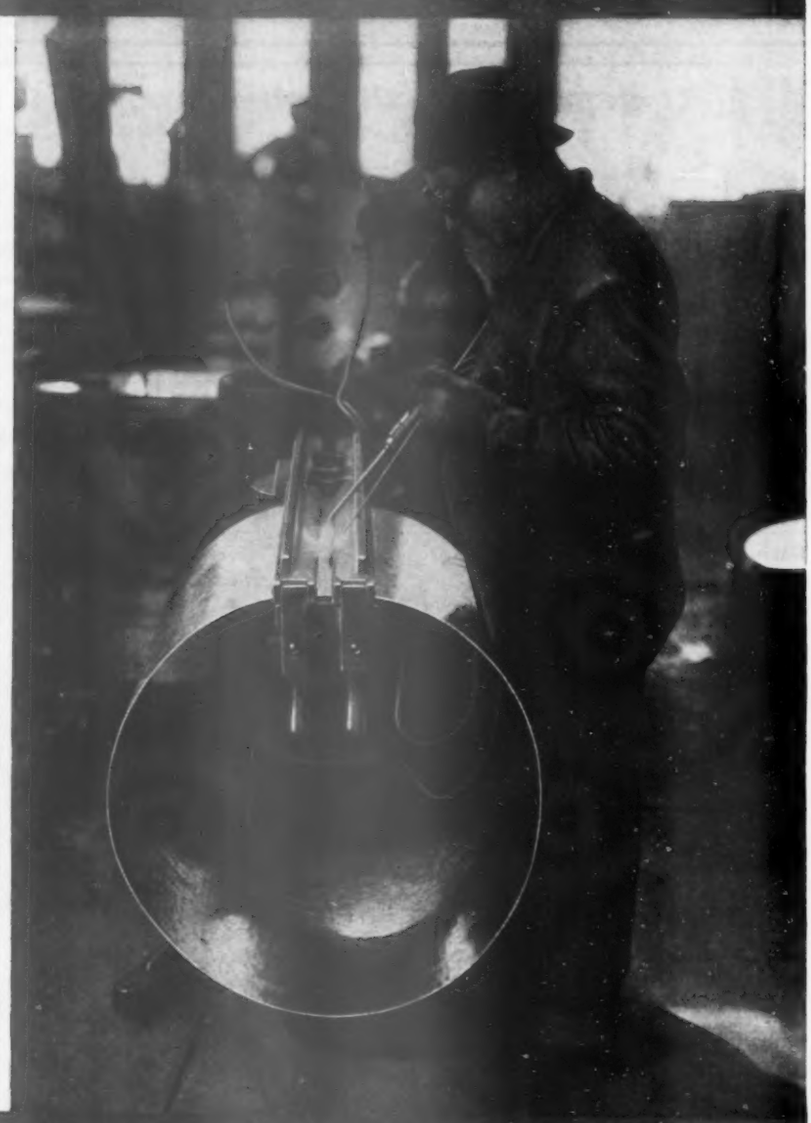
**Position Wanted**—Welder and Machinist with a wide line of practical experience will be open for position January 1st. Address 205, care The Welding Engineer.

**Salesmen Wanted**—To sell and demonstrate arc welding machines in Eastern territory. Must be experienced welder. Best references required. Address 206, care The Welding Engineer.

**Position Wanted**—Gas welder, wants job as aircraft welder. Three years' experience in general shop welding. Address 211, care The Welding Engineer.

# DO IT BY OXWELDING

AS pioneers in every phase of oxy-acetylene welding and cutting, the thoroughly experienced engineering and service organizations of these companies can help you in the proper application of oxwelding to your present work and to new production activities.



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The Prest-O-Lite Company, Inc.

Oxweld
Apparatus and Supplies
Oxweld Acetylene Company

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*General offices*
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New York, N. Y.

*Sales offices in*
Principal cities
throughout the country

*64 Linde plants—45 Prest-O-Lite plants—154 Oxygen Warehouse stocks—138 Acetylene Warehouse stocks—38 Apparatus Warehouse stocks—235 Carbide Warehouse stocks*

PHILADELPHIA, PA.
**Gas and Electric Welding Wire**

# EDGCOMB STEEL

*Distributing for*
AMERICAN STEEL & WIRE CO.

NEWARK, N. J.
**A Type for Every Purpose**

## PREMIER TESTED WELDING WIRE

*Complete Stocks for Immediate Delivery*

***It depends on the job—***

Some welders use Gloves, others prefer Mittens. Some require a heavy Glove, lined, unlined, or reinforced on the palm or fingers; others want a lightweight Glove. Whatever your job requires, we make it in leather or asbestos; also, Aprons and Sleeves.

**THE OLYMPIC GLOVE CO., 611-621 Broadway, NEW YORK**

**Welding Apparatus Salesman Wanted**—Oxy-acetylene. Give full information in first letter. Address 208, care The Welding Engineer.

**Welder**—All around job shop. This is a year around job. Qualify you must be able to handle both electric and acetylene. Must be skilled repair welder. State salary and qualifications in first communication. Pavlik Bros. Machine & Welding Co., Kenilworth, Illinois (suburb of Chicago).

**Position Wanted**—Electric welder with one and a half years' experience. Can weld heavy or light materials. Address Box 209, care The Welding Engineer.

**Wanted**—Welding Engineer for company manufacturing welding wire exclusively. Must be salesman and familiar with the needs of big users of welding wire. Salary and interest in business to the man we hire. Address 210, care The Welding Engineer.

## REP FLUX and REP RODS

**The Solution of Your Problems In The Repair of**
**Scored Cylinders, Water Jackets, Radiators**

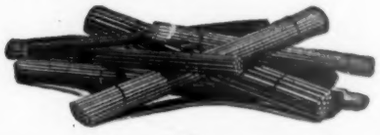
The great need for a Flux which will absolutely Tin Cast Iron has, after years of experiment by the Kansas City Oxygen Gas Co. been supplied in Rep Flux.

Rep Flux will tin any metal but Aluminum — pre-heating unnecessary—only a small flame is needed.

Rep Flux will tin scored cylinders without removing block from chassis. Scores are then filled by applying Rep Rods by small welding flame.

Large returns for small investment.

Complete catalog Welding and Cutting equipment and supplies furnished on request.



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Pioneer Gas Manufacturers of the West
2012 Grand Ave. Kansas City, Mo.

## LOOK AT THIS

**Of All Bargains, This Is Best**

Machine Shop and Foundry combined located in the heart of MUSCLE SHOALS amidst the Nation's richest deposits in RAW MATERIALS can be had with very SMALL outlay of cash, and balance on EASY TERMS. OWNERS RETIRING. Property alone worth practically amount asked for entire business. Annual net income over twelve thousand. ACT QUICK.

**O. P. GREEN, Sheffield, Ala.**

**FOR SALE**—Gibb Arc Welder Serial No. 629-220 Volt 60 cycle 200 amp. 75 KW. In good condition. Used but a short time. Will be sold at less than one half the price of new.

**KEYSTONE PIPE & SUPPLY COMPANY**
BUTLER, PA.

## REBUILT ARC WELDERS

We have in stock General Electric and Lincoln Electric motor drive welders; also GE and Wilson gasoline engine drive welders. We buy, sell and repair welders. We are also factory representatives for new machines.

**GOODMAN ELECTRIC MACHINERY CO.,**
**126 Green St., Newark, N. J.**

## TISCO

**MANGANESE STEEL WELDING WIRE $\frac{1}{8}$" to $\frac{5}{16}$" dia.**
**STOCK SHIPMENTS**

The premier rod for the repair, or building up of worn Manganese Steel Track-work and other castings requiring a hard tough surface. Manufactured by the makers of Tisco Manganese Steel; the first in America to produce this remarkable metal.

WM. WHARTON JR. & CO. INC. EASTON, PA.
TAYLOR-WHARTON IRON & STEEL CO. HIGH BRIDGE, N. J.

# *Let us furnish the correct Seneca*

SENECA Brand Welding Rods are made for a wide variety of uses. We select the materials carefully. Their production is under the strict supervision of men with years of experience. Whatever your welding needs there is a Seneca Brand Welding Rod for them. Tell us your problems; our engineers will select the correct rod for your purpose.

*There is a grade of Seneca to meet every requirement.*

THE SENECA WIRE & MFG. CO.

Established 1905

Fostoria Ohio

*Sales Representatives Wanted—Commission Basis*

Brand
Welding
Rod

You can't afford to slight the metal that goes into your welds.

You can put your confidence into Seneca.

**Membership In The American Welding Society Is Testimony Of Your Interest In Welding.**

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TRADE MARK REGISTERED

**ARC WELDING MACHINES**

WELDRITE Junior
For the welding shop or plant maintenance. 175 Amp. Price $450.

**Proven Superior From Every Standpoint**

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FACTORIES: Detroit, Mich.; Walkerville, Ontario

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WELDERS who use Commercial Acetylene soon learn that every cylinder contains the same pure gas.

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Means pure acetylene.

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Means prompt service.

No matter what your gas requirements may be you will be interested in our sales plan. Ask our nearest office to tell you about it.

Supplied in the following size cylinders:

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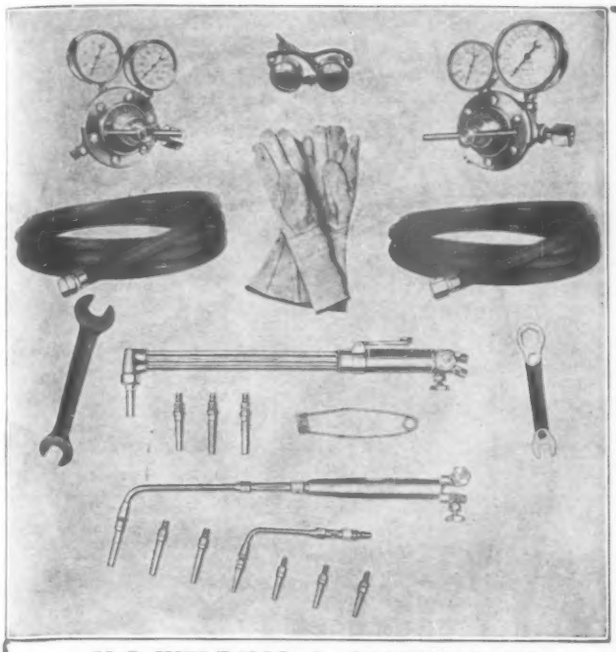

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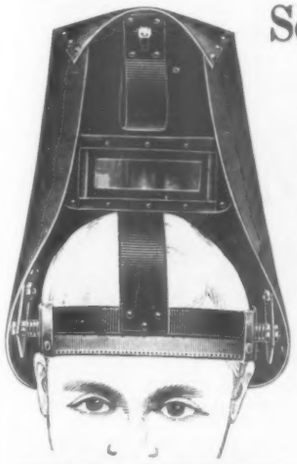

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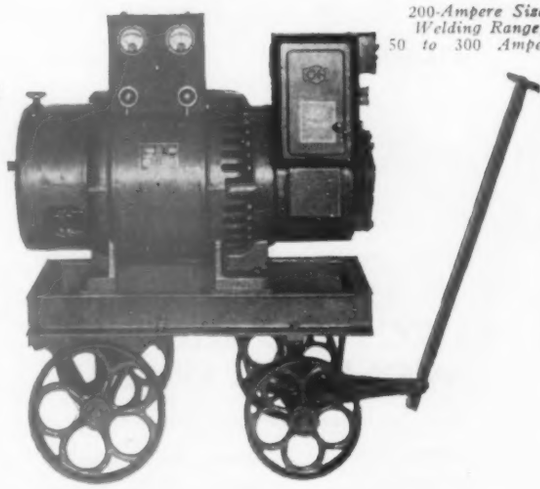

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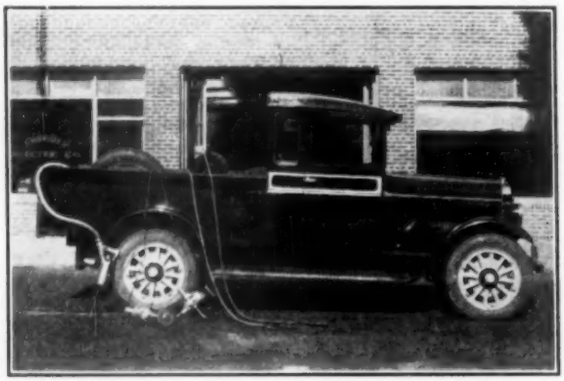

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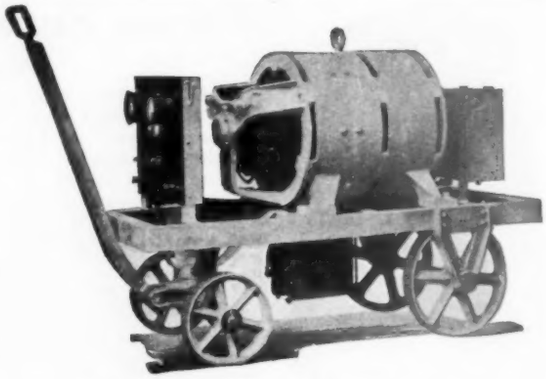

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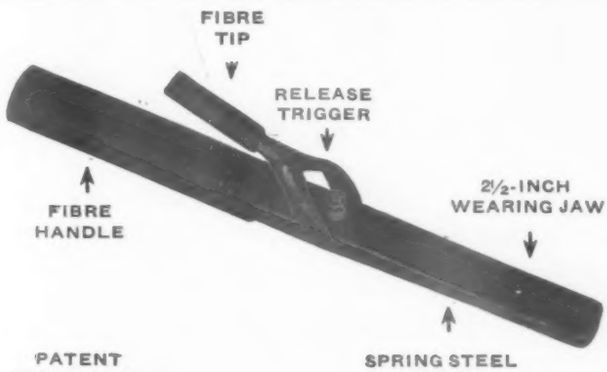


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Uniformly good results have been secured by its use throughout the past fifteen years.
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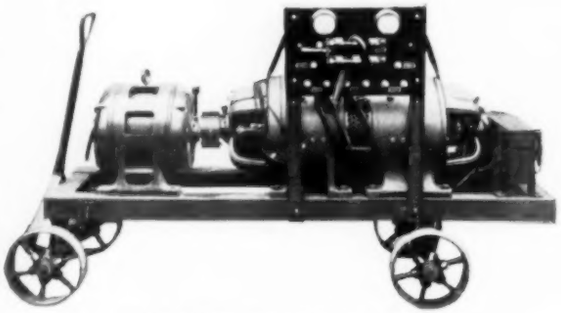
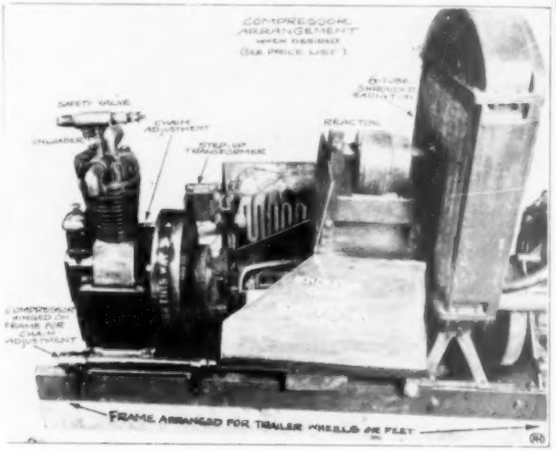
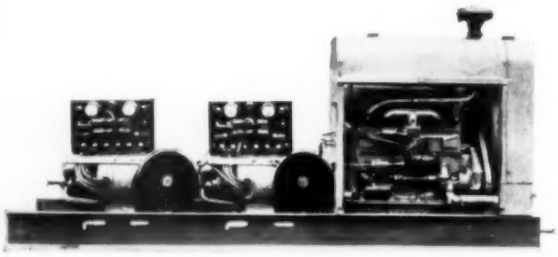


Model R200 with 220-440 A.C. Drive




Model S200 (150 to 300-amp.) Engine Driven with Compressor



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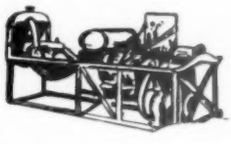

***Send for complete description of the Dualarc Line.***

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